Approach to Development of Urban and peri-Urban Forests in Khartoum State

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قال تعالي :

هو الذي أنزل من السماء ماء لكم منه شراب ومنه شجر فيه تسيمون

صدق الله العظيم

سورة النحل (10)

Dedication

To my great teacher Mohamed peace be upon him he taught us to care about trees one of his Impressive says:" When dooms day comes if someone has a palm shoot in his hand he should planted it"

To the soul of my parents with mercy

To the all lover of trees and environment.

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First my Faithful Thanks and praise to my God who gave me the health and power to complete this work.

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Glossary

FNC	Forest National Corporation
FAO	Food and Agriculture Organization
FOSA	Forestry Outlook Study for Africa
NWFPs	Non Wood Forest Products
CBOs	Community base organization
UPF	Urban and peri-urban forest

Abstract

More than half the area of Khartoum State is either desert or semi-desert. Forest cover is declining as a result of various factors. Khartoum as an urban area is characterized by high wood consumption most of inhabitants depend on wood energy provided from near by forests or remote ones.

The research is aimed at measuring and inventorying urban forests resources, understanding how urbanization impacts local forest stands and assisting city planners in developing appropriate management plan. The argument of the study is that trees and forests in urban areas and urban surroundings are not receiving the attention they need and deserve as compared to the benefits they provide.

Umm-durman locality was selected to represent Khartoum State. Four quarters were selected to represent the urban areas and four villages selected to represent the peri-urban areas. Citizens were interviewed to examine their interest in participation in tree planting programmes and the constraints hindering tree planting activities.

The study relied on primary and secondary data. Two questionnaires were used for data collection in addition to the reconnaissance survey. The techniques of data analysis include tabular, descriptive statistics, and Chi-Square Test.

The analysis revealed that tree planting and green areas in Khartoum State are developing with increasing awareness of communities and presence of a number of organizations and institutions interested in developing tree planting programes. People are interested and practicing planting trees in spite of absence of extension services, or organized work at the level of

quarters or villages and the absence of near by nurseries. People's purposes for planting trees differ according to the need of the area. Coordination, sustained fund, and technical problems are the most constraints in developing urban and peri-urban forests. The survey conducted by the study indicates that a diversity of tree species exists in Khartoum urban and peri-urban areas. These trees are found in two types: planted and natural forms. The survey recognized thirteen tree species that grow naturally in Khartoum urban and peri-urban areas which are known to be producers of valuable products.

The study recommended development of comprehensive urban and community forestry programs that address urban tree health issues and implement long-term tree practices and strategies. All tree planting projects would include maintenance plans and use plant materials that meet the tree health. Define and agreed upon an authorized institute to carry the coordination of programmes and distribution of responsibilities between different institutions and organizations involved and interested in urban forestry development.

الخلاصة

أكثر من نصف مساحة ولاية الخرطوم تقع في الأقليم الصحراوي أو شبه الصحراوي. الغطاء الغابي تناقص لعدة اسباب. الخرطوم الحضرية تتصف بإستهلاك عالي للحطب و المواطنين يعتمدون علي الطاقة الحية من الغابات المجاورة او البعيدة.البحث يهدف الي قياس ومسح الغابات الحضريه، وفهم تأثير النمو السكاني علي الغابات المحلية ومساعدة المخططين في المدينة لتنمية وتطوير خطط للادارة مناسبه.

حجة الدراسه أن الأشجار والغابات في الحضر وماحول الحضر لا تجد الاهتمام الذي تستحقه مقارنة بالفوائد التي تمنحها. محلية أمدرمان أختيرت لتمثيل ولاية الخرطوم وأربعة أحياء أختبرت لتمثيل الحضر وأربعة قري لتمثيل ما حول المدينة. تم استبيان المواطنين في المناطق المختارة لمعرفة رغبة المواطنين ومشاركتهم في برامج التشجير والمعوقات التي تحدهم. الدراسة اعتمدت في جمع البيانات علي أستعمال الاستبيان والمسح الاستطلاعي. تحليل البيانات شمل الجداول، الوصف الاحصائي وجدول اختبار الاحتمالات.

التحليل أظهرأن زراعة الاشجار والمساحات الخضراء بالولاية تنمو مع ازدياد وعي المجتمعات ووجود المنظمات والموسسات المهتمة ببرامج التشجير. المواطنين راغبين في المساهمة في تطوير الغابات الحضرية ويمارسون زراعة الاشجارلاهداف مختلفة بالرغم من غياب الخدمات الارشادية والعمل المنظم علي مستوي الحي أو القرية بالاضافة الي عدم وجود مشاتل قريبة خاصة في القري.

ضعف التنسيق والتمويل و المشكلات الفنية مثل اختيار انواع الاشجارالمناسبة للمنطقة المحددة من أكبر المشاكل التي ذكرت والتي تمثل عائقا في تطوير الغابات الحضرية.

المسح الذي تم بواسطة هذه الدراسة أكد وجود تنوع في الاشجار في الولاية وما حولها. الاشجار توجد في نوعين مزروعة أو طبيعية. البحث تعرف علي 13 نوع من الاشجار تنمو طبيعيا معروفة بانتاجها القيم.

الدراسة أوصت بتطوير شامل للبرنامج الغابي لتتناول القضايا الخاصة بصحة الاشجار وتنفيذ استراتيجيات طويلة المدي لمزاولة زراعة الاشجار. كل مشاريع زراعة الاشجار يجب أن تشمل خطط للصيانة وأيضا الموافقة علي سلطة تقوم بالتنيسيق وتوزيع المسؤليات بين المنظمات والمؤسسات المختلفة المهتمة بتطوير غابات الحضر وما حولها.

Chapter One

1. Introduction

1.1 General

"Urban forestry is the management of trees in a such way that they contribute to the physiological, sociological and economic well-being of urban society. It relates to wooded areas and either isolated or clusters of trees in inhabited zones; it covers many aspects since urban zones contain a wide variety of habitats (streets, parks, neglected corners. etc.) to which trees bring both their advantages and problems"(Carter, 1995).

Urban forestry is a merging of arboriculture, ornamental horticulture and forest management. It is closely related to landscape architecture and park management. Urban forestry includes activities carried out in the city center, suburban areas and the urban fringe or interface area with rural lands (Kuchelmister and Braatz, 1993).

Collectively, the trees existing in cities, whether growing naturally or planted are called urban forests. Although urban forests differ from the expansive forests of natural areas, they are just as important. Tree planting and green area development in Khartoum and its surrounding are developing with increasing awareness of the urban communities. Urban forests are valuable for many reasons. Perhaps the most basic reason is that people like trees and take care about them. Trees are beautiful through out the year with their summer shade and fall colors.

Urban forests and trees constitute attractive homes for animals and communities of birds and insects. Certain species of wildlife, which have adapted well to an urban lifestyle, such as squirrels and sparrows, are the most prevalent.

1.2 Urban Development and Forests

Migration to Khartoum began after independence (1955/56) when laws restricting movement inside the country were abolished and areas previously declared closed were opened. Much of migration to Khartoum in recent years has been a response to a series of natural and non- natural disasters.

The civil war in the south has destabilized life and sent displaced people northwards. Since the mid -1970s, the country has also been receiving refugees from neighboring countries, particularly Ethiopians, Eritrean and Chadian. In 1988, rains and floods, hit the country and large numbers of people left rural areas and small towns and headed towards Khartoum. Before that, desertification and drought in the west had been responsible for a steady stream of displaced people.

Urban development has significantly affected man's relationship with trees and forests. The accumulative effects of population, intensive growth of traffic resulting from the increase in the number of motor vehicles, workshop and industries may have created serious environmental problems in urban area because of poor air quality that may result from development. A study showed that the recorded values of carbon monoxide concentration in certain locations in central Khartoum city area were alarming and may create pollution problems in near future. Noise levels were almost high compared with the British recommended noise level for community.

Urban forest is a very important part of urban ecosystems and provides significant ecosystem services and benefits to urban communities including environmentally, aesthetically, recreationally and economically needed values (Feng; *et al*, 2005). Urban forestry is a practical discipline, which includes tree planting, care, and protection, and the overall management of trees as a collective resource based on integration of efforts. Hence it could be understood that urban forestry is the care and management of urban trees and forests, i.e., tree population in urban settings for the purpose of improving the urban environment. Urban forestry advocates the role of trees as a critical part of the urban infrastructure.

Though, planting of trees in and out urban centers coupled with other control measures have been found to significantly reduce the amount of pollutants in the atmosphere. Trees have been an important part of human settlements throughout history. Trees and green spaces play an important role in improving city living conditions, help keep cities cool, act as natural filters, particulates are removed by trees as they impact on the plant surface, where as No_2 can be absorbed through foliar up take, with some utilization of nitrogen by plants. Other benefits such as climate amelioration, sewage disposal, noise absorbers, protection and improvement of the quality of natural resources, including soil, water and vegetation are of importance to mankind.

1.3 Benefits of Urban Forests

Urban forests provide a broad array of well-known environmental, economic, and social benefits. Clearly, urban forests have a substantial monetary benefit to the municipalities, provincial and federal governments (storm water attenuation, air quality mitigation, tourism, health and care costs, etc.), to residents (property value, energy conservation, cooling, shade, and wind reduction etc.) and business

(tree care companies, nursery industry, aesthetics of retail areas) to the public (Provision of wildlife habitat).

Trees also are useful in combating sand dunes movement and increasing agriculture production as well as provision of leisure and recreation. Trees are on the job every day working for all of us to improve our environment and quality life. Without trees, the city is a sterile landscape with concrete, bricks and asphalt. Now 75% of us live in cities and towns, we can act individually to improve our natural environment through planting and care of trees on our streets, houses, and by supporting community forestry programs. We learn more about trees and how they benefit mankind and these trees make up our urban forests.

In the past, urban forestry in developed countries was considered almost on the basis of its aesthetic merits. Now, a closer look is being given to the environmental services and quantifiable economic benefits they provide. In most developing countries, government and international support for urban forests has been limited in spite of the role they played. Most of Khartoum State inhabitants depend on wood energy provided from near by forests or remote ones.

Table (1.1) shows the extent of dependence of households in Khartoum State on wood fuel as reflected by the wood consumption survey (1994). Wood energy provides energy equivalent of 80% of total energy in Sudan. This situation might have started to change by provision of other alternatives particularly Liquid Gas Oil which may increase with increasing oil industry development in Sudan, but it may take sometime before alternatives are made available on large scale.

Table (1.1) Household depending on wood fuel in Khartoum State expressed in percent

Household	Firewood	Charcoal	Firewood and charcoal
Urban	65.6 %	88.9 %	97 %
Rural	85. 1 %	32.3 %	93.6 %
N. Sudan	79 %	50 %	94.8 %

Source: Wood Consumption Survey 1994.

In Sudan considerable efforts have been undertaken by the different governmental institutions mainly Forest National Corporation (FNC) to encourage citizens and non-governmental organizations to pant trees and to raise awareness through different means and activities, such as broadcasting special programmes through television, radio and other mass media, celebration with different occasions such as tree Anniversaries Arbor day , and international environmental day, besides special programmes to schools at different levels. These activities increase the chances for more concern towards tree planting. Also training is provided to different target groups (farmers, teachers and women). All these programmes and activities meant to raise the awareness of people about importance of trees and forests and to encourage their participation in such programmes based on availability of seedlings from government nurseries at low prices, some time offered free.

Other government institutions and education collages, have also statistically contributed in the dissemination of tree panting culture. Other efforts taken by donor projects like FINNIDA, and non-governmental bodies such as public committees, environmental societies, youth unions, as well as individual initiatives have some contributions in increasing tree planting at urban and peri-urban sites. However, there is a little or no co-ordination between those different departments, bodies and institutions in charge of urban forestry. This situation

has led to financial and human resources waste. Thus, the potential role of urban forestry should be fully explained and thoroughly studied so as to enhance the work of decision makers, city planners and landscape designers.

The aim of the present study will be contained in trying to investigate the role played by different organizations, and their collaboration at household level, in developing urban forestry in the state. The study will also identify the institutions in charge of implementation, education, training and extension activities related to this field to come out with an appropriate strategy for urban forestry management. In addition, the study will investigate the role played by forestry institutions in the field of urban forest development in Khartoum state.

1.4 Problem Statement

Due to the intensive efforts of the forest extension service, attitudes towards forestry have changed favorably in Sudan at different levels. In reviewing programmes and activities related to social forestry in Sudan it has been found that there is growing awareness towards the importance of growing trees and forests. The need for forests development in relation to urban and peri-urban areas may encourage people to provide their experience in dealing with forests and trees. Donor-funded projects, government institutions and non-governmental organizations have worked hard in the field of raising people's awareness and encouraging their participation in issues related to development of forests and tree plantation at rural and urban areas. Such development faced with several technical problems including maintenance activities, selection of appropriate tree species and lack of co-ordination. In spite of the constraints, success in initiating urban forests has been to some extend achieved and their experiences are

documented. However, these efforts are scattered and there are no clear systems for monitoring and evaluation of their programmes.

It is argued that trees in urban areas have not received the attention they need and deserve, and there is no cohesive and unified policy for urban forests and trees development and management in urban Khartoum. Hence, the development in this sector is shaped by inconsistent decisions taken by different bodies and population who have their own alternatives and choices. Urban forestry programmes can not be carried out by a single institution but needs collaboration between different government institutions, public sector, researches, academic institution, private sector, non-governmental organizations and any interested parties.

1.5 Objectives

The main objective of the present study is to evaluate the situation of urban forests taking Khartoum as a case. Particular objectives are to**:**

1. Carry general assessment of the status-quo for tree planting and forestry activities underpinning such kind of situation in urban Khartoum.
2. Investigate the measures to be adopted to improve the recent development in this sector, and help formulate appropriate policies for urban and peri-forests Khartoum.
3. Identify the organizations and institutions concerned with urban forests and assess extent of co-operation between them.
4. Investigate people’s willingness and attitudes towards tree planting at urban and peri-urban environments.

Chapter Two

2. Literature Review

2.1. General

Urbanization has been expanding in the Sudan during the last two decades in association with of the high rate of social and economic development of cities and towns. Linked with urban expansion, is the phenomenon of environmental degradation which is becoming a major issue in cities and that will affect their sustainable development. Population growth in the period 2000 -2030 will occur primarily in urban areas mostly in the developing world (Wolman 2005). Urban population in Sudan has increased by 50% between 1993- 1996. Khartoum accommodated 20% 0f the total population in 2002. Almost all urban development such as road, high towers, airports and industries have some impacts on the urban environment. Urban forests represent activities of planting trees inside home yard, along streets, in parks and landscape surrounding urban centers.

Increase of urban population is greatly enhanced by migration and displacement which both leads to increasing settlements in cities and consequently result in expansion of cities and towns areas. Through planting and conservation of trees growing in urban and peri-urban sites, biodiversity may be given good chances for development. Different people have different interest in tree species for certain beautiful components such as flowers, green color, shape, structure and height. Some may like fruits and other may develop trees for bee keeping. The different in likeness of trees create the opportunity for planting and conservation of different trees and consequently

resulting in developing of a diversity of tree species. Existence of arboretum and nurseries in urban areas still provides good chances for biodiversity development in urban cities.

Khartoum is experiences various pressures that leads to urban expansion and necessitates that polices should be adopted to ameliorate environmental hazards resulting from such expansion. Tree planting and conservation are important activities to be adopted for improvement of the urban environment of Khartoum.

2.2 Definitions and concepts

With increasing urbanization in 20th century, the incorporation of trees into urban settlements has also increased to the point that the management of trees within the urban area is considered a distinct discipline of forestry. Urban forestry was conceptualized in the late 1960s in North America, and grew out of what was initially termed environmental forestry (Miller 1988).

Urban forestry is the sustained planning, planting, protection, maintenance, and care of trees, forests, green space and related resources in and around cities and communities for economic, environmental, social, and public health benefits for people. The definition includes retaining trees and forest cover as urban populations expand into surrounding rural areas and restoring critical parts of the urban environment after construction. Expansion at the urban/rural interface raises environmental and public health safety concerns, as well as opportunities to create educational and environmental links between urban people and nature. In addition, urban and community forestry includes the development of citizen involvement and support for investments in long-term on-going tree planting, protection, and care programs(Deneke

1993).

Generally urban forests are collective masses of trees found within the boundaries of cities (Saeed 2006).Different forms characterize the tree collection on urban sides. Planned landscape composed of planted trees constitutes the major feature of urban forests. Other forms may be composed of untended collection of trees that grow on un-managed sites. According to miller (1988), each of the urban forest setting has important functions. Urban forest is defined as a collection of trees that grow within a city, town or a suburb including any kind of woody plant vegetation growing in and around human settlement in urban areas.

In developing countries, urban forestry must initially focus on helping to fulfill immediate requirements for basic products. Recreation, although increasingly necessary, is less essential. Assistance in meeting basic needs can best be achieved by promotion of multiple uses of urban forest resources (Kuchemeister 96; Lanly 97).

Too many cities are still designed strictly from engineering perspective. Urban vegetation is often considered less important than the build structures, roads, and utility layers; yet vegetation must be included in the planning process if healthy urban ecosystems are achieved. (Moll, Macie and Neville 95; Whiston Spurn 84).

2.3. Urban Forest Management

The concepts of urban forests management puts responsibilities on the hands of various stakeholders to contribute in urban forests development. Urban forestry is practiced by municipal and commercial arborists, foresters, environmental policy makers, city

planners, consultants, educators, researchers, and community members (Nowake 2000).

Grey (1996) stated that comprehensive urban forest management must be certainly authorized, vested in a single organization, such as a city forestry department, with responsibilities for both direct and indirect management of all sides of urban forests. It may mean that on government lands, the city forestry authority exercises direct management that ensures compatibility of trees with urban environment while on privately owned sites the management takes an indirect approach, mostly through cooperation and educational efforts. Accordingly, the role of government and NGOs is to facilitate support to stakeholders in adoption of such approach of collaborative efforts with the citizens that constitute the majority of people concerned with tree planting.

Management goals should be based on an understanding of public attitudes, perceptions, and knowledge, a review of the agents in change, and the expressed needs and concerns of the community. These goals should be compared to a dynamic or temporal description of the resource based from inventory and management objectives (Mudrack 1980).

Management challenges includes maintaining tree and planting site, inventory, quantifying and maximizing the benefits of trees, minimizing costs, obtaining and maintaining public support and funding, and establishing laws and policies for trees on public and on private land. (Mudrak 1980).

Fundamental to the concept of comprehensive management of urban forests is visualizing the total urban forest area and understanding the location, ownership and condition of the urban forest that appear in countless situations of tree-lined streets, highways nearly barren of trees, open areas, areas with occasional trees and other forms all represented by a myriad of owners and each fall within a particular land use category (Grey 1996).

Urban forestry is a practical discipline, which includes tree planting, protection, and the overall management of trees as acollective resources based on itegration of efforts. This enables community to manage trees as groups of populations within the context of entire community resources (Ichimura 2003).

As more is learned about the physical and biological properties of urban trees, more care practices can be done and hence best benefits of trees can be gained (Anyanwu and Kanu 2000). Hence it could be understood that urban forestry is the care and management of urban trees and forests, making tree population in urban settings for the purpose of improving the urban environment.

There are many differences between the management of trees in an urban environment and "traditional" rural forestry. In many cities, trees are a minor part of the landscape, particularly in the centre. Cities present harsh conditions for tree growth. Even in those which have large tree cover in their central urban area and/or suburban areas, management is complicated by the fragmentation of green space. The objectives of tree-planting, the location, the configuration of planting and the management of the trees in urban areas differ from those in rural areas. Socioeconomic conditions and requirements can be quite different and more variable in a city than in the countryside. In

addition, the availability of technical information on which management decisions or urban/peri-urban forestry can be based is still limited, particularly in developing countries (Kuchelmeister, 1991)

2.4. Urban Forests Benefits and Values

Urban forest is very important part of urban ecosystems and provides significant ecosystem services and benefits to urban communities including environmentally, aesthetically, recreationally and economically needed values (Feng;*et a*l 2005). The ecological approach to urban forest management is an old concept expressed in the principle that urban forestry deals with city trees as well as with tree management in the entire area influenced by and utilized by the urban population (Saeed 2006). The urban forest area naturally includes surface water, forests, trees and recreational areas serving the urban population within the entire geographical area influenced by urbanization (Wolman 2005).

The health of urban forests contributes to both the socio-economic and environmental well-being of the urban communities (Kolstad 2000). Research on urban forests, investigates the effects of urban forests and their management on human health and environmental quality. Urban forestry advocates the role of trees as a critical part of the urban infrastructure. Urban forestry presents many social issues that require addressing to allow urban forestry to be seen by the many as an advantage rather than a curse on their environment. Trees play a social role in easing tensions and improving

psychological health; one study has demonstrated that hospital patients placed in rooms with windows facing trees heal faster and require shorter hospital stays (Ulrich, 1990). Green areas are important recreation sites in most cities lower income residents are more likely to frequent city parks in their leisure time than are wealthier citizens (Sorensen 1996). Thus, loss of green space for recreation affects the urban poor most directly (Hardoy, Mitlin and Satterthwaite 92).

2.5 The philosophy of plant life in the Quran

The holy Quran and hadith in order to preserve the ecological balance tries to create a friendly attitude towards plants and trees not only prevent people from cuttings trees but also take the positive step of caring and looking after them. Also in one of his advices to the Muslim army, the first Khalifa, Abu Bakr al-siddig, if the army enter towns or conquer land he asked the soldiers not to cut or burn fruit trees. (Zeidan 1985).

To stress the importance of trees and plants in general, the holy Quran gives us awful pictures for drought and desertification in many verses associated plants with life to show that they are precious and desirable, and associated drought and desertification with death to show that they are awful, horrible and miserable. (Zeidan 1985).

Quran and hadith have been systematically screened for any hint on forest and environment. Each tree you plant brings you step nearer to paradise. Many Quranic verses mention trees; verses on gardens and palms trees are plentiful in the Quran. The most impressive hadith has been reported by al Bayhaqi : " When doomsday comes if someone has a palm shoot in his hand he should

planted it". Environmental protection can clearly be based on religious awareness and Islamic guidance (www.brainworker.ch/reports/yemen).

2.6 Policies and Legislations relating to people Participation in Forest Management

The first policy statement on forestry was issued in 1932. The objective of this policy was the reservation, establishment and development of forest resources for the purpose of environmental protection and meeting the needs of the population for forest products.

In 1986 the 1932 forest policy was revised tended to involve people in tree planting and emphasized the protective and environmental role of the forests. Sudan attended UNCED in Rio in 1992 and signed the conventions on biological control and agreement on climate. In 1994 it also signed the convention to combat desertification. The policy encouraged for the first time the establishment of community forests as well as private and institutional forests and stressed the role of forest extension. Also raised the national goal of forest reserves from 15 to 20% of the total area of the country. In 1989 the forest act legalizes people participation. For the first time, the Act recognized the right of ownership of forests by private sector and local communities.

According to El Mahi (1997) the definition of ownership in the Act enters owners other than government for the first time in forestry history. The Act defines communal forests as those established by citizens in their farms and around the cities and villages. The Act also contained items encouraging the cooperation between the government and the public. The Sudanese Constitution (1998) states that the conservation and protection of environment is both a right and responsibility of the people. In 2002 the Forests and

Renewable Natural Resources Act was enacted and published the law include the participation of native administrative in the protection of forest (Ibrahim 2003). Kanoan (2004) both 1989 act and 2002 Act introduced new mechanisms for the promotion of private and community forestry. In 2005 a new forestry policy proposal was formulated.

Chapter Three

3. Study Area

3.1 Location

Khartoum, the capital of the country, is composed of the three towns: Khartoum, Omdurman, and Khartoum north, forming the biggest and densely populated city in Sudan. Its area approximates 22000 km^2 equivalents to 0.84% of the total area of Sudan. It lies between Latitudes 14^0 30' and 16^0 45' N and Longitudes 31^0 36' and 34^0 25' E. It is the most urban and densely populated urban center compared with other urban areas. The estimated population in 1993 approximates 2.8 million persons growing at a rate of about 7% per year (Population census, 1993). Khartoum has the highest density amounting to 169 person/sq km. The high density is creating various problems from political, economic, social and environmental points.

3.2 Climate

Khartoum lies in the climate of semi-desert to dry. It is hot, dry and rainy during summer, cold dry in winter. Most of rains fall during July and August. Annual rainfall varies from 75 - 300 mm/year falling in 2 – 4 months between July to October. The dry season may continue over 8-10 months. The daily average maximum temperature 37.7^0 C and May exceeds $40C^0$, while the daily average minimum temperature may record 21.6^0C, and may reach 5.2^0C in winter.

3.3 Administrative Structure

Administratively the state is divided into seven localities as follows:

1. Khartoum Locality
2. Omdurman Locality
3. Khartoum North
4. East Nile
5. Umbadda Locality
6. Jabal Awlia Locality
7. Kerri locality

Every locality is divided into small administrative units; each unit is composed of number of quarters or villages. The locality supposed to offer the necessary needed services for the community including education, health, even planting trees and others.

3.4 Some Demographic and Social Aspects OF Khartoum State

Khartoum as an urban area characterized by dense population is facing various problems of social and environmental nature.

3.4.1 The Effect of Rapid Growth Rate on Urban settlement

Urban population in the country was increasing faster than the rural population as reflected in results of successive population Census. The distribution picture as in the 1983 was that 20.5% of the population were urban, 68.5% were rural while 11.0% were nomads. The 1993 population Census indicates that changes occurred from that of 1983 in that 29.3% were urban while 68.1 %were rural population and the remaining 2.6% were nomads. These changes indicate the

progressive development into urban citizens. The average annual growth rate of Sudan was reported as 1.9% during the period 1956-1973; increasing to 3.9% during 1973-1983 and decreased to 2.6% for the period 1983-1993. The urban population in 1993 was 2.92 million representing 11.4 %of the total population of Sudan and about 42.0% of the total urban population of the country and 29.3% for Khartoum.

The explosive growth rate of Khartoum state is expected due to internal migration to the state, and displaced people from different states of the south due to civil war, drought and desertification in other part of the country. These factors resulted in an increasing demand for urban services, particularly housing and wood energy.

3.4.2 The Education Effect

Khartoum State showed the highest literacy rate among population aged 10-years and over reaching 72% (Results of the last population Census of 1993). The urban areas showed 61.3% literacy rate while the rural areas showed only 10.6%.Literacy rate among the male was highest than that of the female.
The change in the educational system which took place increased the opportunity of attending schools for all children in the school age in urban areas as well as the rural.

3.4.3 The Housing and Health Effect

The better living and good health services and labor opportunities in Khartoum attracted all types of migrants. Poor conditions resulting from civil war and drought created health hazards, increasing poverty, and spread of diseases in

west and southern Sudan. The continuous influx of migrants and displaced people made the situation in urban areas harder to be controlled.

Table (3.1) shows the distribution of poverty and its growth indicated that Khartoum State was the best place to live in.

Table (3. 1) Regional poverty distribution and the growth rate of poverty in Sudan (1990-1996)

Region	Percentage of poor 1990	Percentage of poor 1996	Annual growth rate
Khartoum	71.8	75.4	0.8
Darfur	72.0	95.4	5.5
Northern	77.2	93.2	3.0
Central	78.0	91.9	2.6
Eastern	80.0	90.7	2.0
Kordofan	84.0	94.2	1.8

Source: Labor Force and Migration surveys of 1990 and 1996, Ministry of Manpower, Khartoum.

3.5 Natural Forests and Vegetation

Sudan was the home of great coniferous forests that cover the soils of Nubian and Western deserts in the remote geological past. Fossil coniferous stems forty million old are seen littering the sandy plain North of Omdurman.

Forest in northern parts of the Sudan is constantly changing from the coniferous forests and the moist tropical forests to the present denuded sandy undulating plains (Badi 1989). The forest tree vegetation cover was estimated in 1901 at 40% of the total area of the Sudan. It was estimated to be 34-36% by the middle

of the 20th century (Harrison and Jackson 1958), and in 1990 the area declined to 27% (FAO 1990). Then the forest cover started to decrease to the range of 13.7 – 19.0% at the different states (Forest National Inventory 1998).

The annual total consumption of wood is estimated at 16.5 million m3 (Forest National survey 1996). This is equivalent to harvesting some three million feddans of natural forests (Hasabelrasoul 1996). Larger areas are annually cleared than the planted area. For every thirty hectares cleared only one hectare is planted, (Elsiddig, 2004).

More than half the area of Khartoum state is either desert or semi –desert. The area of semi-desert region constitutes approximately 491 sq km or 19.6% the area of the country.

Many kinds of indigenous trees grow naturally in the state. The vegetation cover is sparse associated with mixture of grasses and herb. The biomass is very poor. Sudan ecological classification places Khartoum state in the *Acacia tortilis-Maerua crass folia* subdivision of semi-desert. *Acacia tortilies* is a constant feature of this Subdivision; *Maerua crassifolia* is present in considerable amount. *Acacia raddiana* and *Salvadora persica* are abundant on sandy drainage lines. *Capparis deciduas, Ziziphus spina-christi* and *Balanites aegyptiaca* are found on clay drainage lines.

Dominant grasses are *Cynodon dactylon* and *Echinochloa colonum*, *Aristida sp* and *Dactyloctenium aegyptica*. The dominant herbs are *Cassia sienna* and *Argument Mexican*. Although there is no change in floristic composition, changes in the species density could be observed (Sudan country Study on biodiversity).

Khartoum state is threatened by desert encroachment, drought, fire hazards, harvesting of plants for building, in addition to overgrazing by the local livestock

due to animal concentration on their way to local and export markets. This creates pressure on the available natural grazing resources, because the semi-desert bushes and trees are valuable browse species for livestock. The species *Acacia tortoilis, A.radiana* and *Leptadenia pyrotcnica* are considered endangered, they are threatened by lack of natural regeneration. The artificial regeneration was not successful. *Capparis decidua* is classified as stressed. Its natural regeneration is poor and artificial trails for regeneration were not successful, *Calotropis procera* indicate heavy overgrazing.

Table :(3.2) the most important forest tree species in Khartoum state

Scientific name
Acacia ehrenbergiana
Acacia nilotica
Acacia seyal
Acacia tortilies
Boscia senegalensis
Calatropis procera
Capparis decidua
Leptadenia py rotechnica
Phoenix
Ziziphus spina-christi
Acacia nubica

Source: Sudan country study on biodiversity

3.6 Trees Planted Inside Khartoum State

Al- Sunt Forest on the eastern bank of the White Nile. It considered the main urban forest located in the center of Khartoum city. First plantation was carried in 1921 in the colonial period for the production of fuel wood to supply the ships with fuel. People have rights such as fishing, hunting, seed collection, grazing and cultivation. Certain privileges were granted to the local people namely dry twigs and Sunt pods collection, the pots locally known as (garrad) are used in local tanneries for treatment of hides and skins. The forest is frequent by visitors for picnics. Many people considered it as very important site for recreation especially in holidays and seasonal occasions, this let the forest department to change the objectives of its management instead of fuel wood production the forest is managed and kept as a national garden for recreation and leisure, the forest used by forest collage, environmental studies students and others for training and researches purposes, also it consider as an important habitats for birds it is part of the bird sanctuary, many beautiful birds are seen ,also monkeys are present, so it is protected and had been declared as a natural conserved area. The forest is a RAMSAR site and as such it is a great bird attraction.

Other formations include Avenue trees such as the Sudan Mahogany on the Nile Avenue, Labakh on part of the Nile, Khartoum University and Palace Avenues. Neem on most of the streets in Khartoum 2 and Khartoum 3. Individuals trees, shrubs and a variety of ornamental plants in public gardens, homes, government buildings and premises of commercial, industrial or private enterprises (AbdAlnour, Khartoum 2005).

3.7 Land Utilization

Land in Khartoum state either irrigated or rain fed. The total irrigated area is approximately 0.46 millions feddans and that of rain fed area is 0.15 millions feddans, constituting 75% and 25% of the total land area respectively.
Land Tenure systems were ownership, rent, acquisition and tribal.

Chapter four

4. Methodology

4.1 Introduction

The methods of the research included selection of the study sites in Khartoum area, sample selection, target groups, procedure of data collection (questionnaires and survey) and data analysis.

The study was conducted in a procedure that facilitated identification and listing of tree species in natural form or planted and to evaluate the extent of diversity of species in existence and use in Khartoum. Species description covered the types of forest products used in Khartoum as conducted by consumption surveys. Description of the per capita consumption from wood products facilitated development of the relationships between forest uses and urban dwellers.

The study utilized data collected on people relationships to tree planting which facilitated description of the situation of tree planting activities in Khartoum state, the participation of local people and the main problems and obstacles facing them. Also to investigate the measures to be adopted to improve the development in this sector and to identify the organizations and institutions concerned with urban forests and the extent of the co-ordination between them.

4.2 Data collection

Data collection included secondary sources and primary data.

4.2.1 Secondary data

The main sources for this data were documents, official reports, researches findings, books, scientific journals and web site. Secondary data facilitated the understanding of the principles for research design and analysis.

4.2.2 Primary data

The primary data was collected from the field through the survey and questionnaire. The data on survey were used to identify and list tree species, their frequencies and nature and origin as indigenous or exotic, planted or natural and to recognize areas of concentration. The data of the questionnaire were principally collected to examine the attitudes of the local people towards trees, their willingness to participate and their perceptions towards trees.

4. 2.3Questionnaire Design

Two types of questionnaires were designed. One for the household composed of 32 different questions, closed-end questions, with mostly multiple choice or yes or no style of answers. This type of questions was used to permit easy, quick and accurate analysis of answers. The other questionnaire was designed for the organizations and institutions interested in tree planting activity and involved physically or in any other form. Questions are concerned with the programmes or the activities of the organization or institution concerned with tree planting and willing to co-ordinate with others.

4.3 Preparation of data collection

A small session for the data collectors was held, 13 persons, nine are forestry officer and four are students of forestry college. The questions were discussed thoroughly and theirs comments helped in the formulation of the last draft of the questionnaire. The data collection took two months.

4.4 Revision of questionnaire

The questionnaire was revised by three qualified forestry officer from FNC head quarter, and one assistant teacher from the statistic section of School College of math Khartoum University, to estimate how the respondents will be able to respond to the questionnaire and to test the reliability and validity of the data for answering the problems under investigation. Their comments were considered. Finally the supervisor checked and revised the questionnaire and accordingly, some questions were added and clarified and so the final format of the questionnaire was constructed.

4.5 Selection of the study area, units and quarters

Umm-Durman town was chosen for the study, taken randomly by assigning numbers from 1 – 3 for the three towns and then picking one out of the three and also Umm-Durman locality was chosen randomly by the same procedure out of the seven localities. The locality is composed of nine administrative units, every unit formed of a number of quarters. The household survey report (2003) was taken from the Information Center of the locality, and was used as the main reference for the selection of the units and so the quarters. The selection of the administrative units and quarters was done by the table of random numbers. Selection of the household was done randomly. The quarters selected included El -abasia, El-shohda , El-arda north, and Bat-Almal. The villages included Jebal El-tina, El-migdab, Goz Ebrahim and Aid Abouzeed. Accordingly four quarters and four villages were selected for the study.

4.6 Sampling and Sample Size

The administrative units of the locality were divided into two layers to facilitate the sampling process; the cluster random sample was used to select the quarters

and villages. The sample size depends on the numbers of household in the locality.

4.6.1 Sampling

Stratified random sampling technique was used where the administrative units was divided into two layers, peri-urban and urban area. The first layer (peri-urban) composed of 60 quarters and villages. The cluster random sample was used where four villages were selected randomly. The second layer (urban area) composed of 8 units. The cluster random sample was used in two stages, first two administrative units were selected randomly from the total number of the eight units, and then the cluster random sample was used again to select two quarters randomly from each of the two units.

4.6.2 Sample Size

To estimate the sample size of the study area the following equation was used:

$$n = \frac{N\sum_{j=1}^{L} N_j p_j q_j}{N2A + \sum_{J=1}^{L} N_j p_j q_j}$$

From the equation:

n= Sample size

N= Size of the society

Nj= Size of society in strata j

Pj=the percentage of the character wanted to be measure.

A=B/4

N1 (peri-urban)

N2 (Urban)

B=estimation error

Sample size=350

4.7 Analysis of Data

The obtained data was analyzed using the Statistical Package for Social Science (SPSS).

1. Descriptive Statistics:
   Frequency Tables
   Bar Chart

2. Cross Tabs (Chi-Square Test for independency)

Chapter Five

5. Results and Discussion

5.1 General

The following section in this chapter provides descriptive formats to link between the increasing urban population, forest products consumption and relationships between urban dwellers and urban trees and forests. Urban trees biodiversity and frequencies of occurrence are presented in tables that show relative abundance of urban tree species on different sites inside urban areas and peri-urban areas. Following that, the attitudes and perceptions of the urban and peri-urban population were presented in tabular forms.

5.2 Khartoum population

The population in Khartoum is increasing in a normal growth but also is increasing as a result of migration.

5.2.1 Urban Population increasing trends

Table (5.1) shows that the components of the three towns (Umm-Durman, Khartoum, and Khartoum North) are differently populated. Umm-Durman contains the largest population representing 42.7% followed by Khartoum representing 33.1% and Khartoum North with 24.2% (Census 1993 extrapolated to 2006).

Table (5. 1) Population of the Three –Towns Capital, Khartoum

Locality	population by State (1993)	Percent of State	Total population 2006	Percent of State
Umm-Durman	1208000	42.7	1920406	42.7
Khartoum	996000	33.1	1488652	33.1
Khartoum North	716000	24.2	1088380	24.2
The Three-Town Capital	2910000	100.0	4497438	100.0

Source: Population Census 1993

The population of the three towns has almost doubled, increasing over the last 2.5 decades from 2.91 million persons to 4.5 million persons. An appreciable part of the increase in population is contributed by migration of displaced people. Such high rate of increase imposes various problems including environmental changes. An increase in settlement areas dictated expansion in urban settlement and reduction in the vegetation cover of the surrounding areas. Khartoum is loosing the cover of trees surrounding it. The green belt was established south of Khartoum in 1961/62 on total area of 7035 feddans to absorb the sewage water, conserve the soil, and supply the capital's need for fire wood and round building poles as well as provision of recreation service to the citizens. Presently, that small part of urban forest has completely been felled down for urban expansion.

5.2.2 The household's size

Increasing urban population is associated with increasing number of households. Khartoum State showed an increase in the total number of households from 180850 in 1973 to 570875 in 1993 to 713879 in 2006 (Table 5.2).

Table (5.2) Number and Average Household Size in Khartoum State: (1973, 1983, 1993 and 2006)

Year	Mode of living	Number of households	Number of population	Average size of household
1973	Urban and Rural	180850	1095617	6.06
1983		275178	1671692	6.07
1993		570875	3510881	6.15
2006		713879	5265910	6.2
1973	Urban	132527	684294	5.98
1983		215359	1332210	6.19
1993		465760	2919773	6.27
2006		713879	4497438	6.3
1973	Rural	48323	311323	6.44
1983		59819	339482	6.1
1993		105115	592372	5.63
2006		125979	768472	5.7

Source: The Central Bureau of Statistics, Khartoum

The number of household in the urban area increased from 73% to 85% of the total number of households in Khartoum State while the number of households in the peri-urban and rural areas decreased from 27% to 15% of the total number of households in Khartoum State over the period 1973 to 2006 (Table 5.2). Increasing number of households indicates the expanding residential area and increasing demand for forest products goods and services.

5.3 Wood Products Consumption

Table (5.3) shows the consumption of wood fuel at the household level and per-capita as inventoried in 1994 (FNC 1995). Table (5.3) indicates that the total per-

capita wood energy consumption at the urban society level is higher than the peri-urban society consumption indicating 0.71 and 0.63 respectively. However, when the equivalent wood energy is broken into charcoal and fuel wood, the per-capita consumption at urban sites is almost three times that recorded at the peri-urban given as 0.57 m^3 and 0.17 m^3 respectively. The case for firewood is reversed, recording 0.14 m^3 and 0.46 m^3 respectively. The per household wood energy consumption followed the same trend, (Table 5.3).

Table (5.3) Annual per household and per-capita wood fuel consumption at the household level In Khartoum State

Category	Household consumption per year		per capita consumption per year		
	Firewood M^3	Charcoal Kg	Firewood M^3	Charcoal M^3	Total M^3
Urban	0.78	711	0.14	0.57	0.71
Rural	2.08	218	0.46	0.17	0.63
N. Sudan	1.67	372	0.36	0.31	0.67

Source: Wood consumption survey, 1994

However, table (5.3) presents the relationship of urban and peri-urban dwellers to trees and forests and also indicates the need of these communities for important forest products like wood for energy at urban and peri-urban areas situated in dry semi-arid conditions. Taking the per-capita consumption of 0.71 m^3 for urban sites and 0.63 m^3 for peri-urban sites, these figures represent very large volumes when compared with the yield of semi-arid zones that rarely exceeds 3 – 4 m^3 of wood per hectare. That means the per-capita need for wood energy at Khartoum State is equivalent to 15 – 21 % of the volume stock of the scattered shrubs and small trees in the semi-arid areas of Khartoum State.

Khartoum is one of the states characterized by high consumption of wood energy in Northern Sudan. Table (5.4) indicates the position of Khartoum State in the list of States ranked in relation to wood energy consumption and the use of alternatives. With regards to charcoal consumption, Khartoum ranks at the top of all states indicating the highest percent of consumed charcoal in 1994 while Khartoum ranks in position number six with respect to firewood consumption. That may mean that the contribution of Khartoum State in forest removal as well as in wood fuel burning is the largest. In this respect, Khartoum is an important contributor in environmental issues related to forestry. However, Khartoum ranks number ten in using energy alternatives for wood.

In spite of the increasing shift in energy consumption towards alternatives like Liquid Petroleum Gas at the urban and peri-urban areas in Khartoum State, yet the needs for wood energy will continue at the peri-urban sites. The importance of these forests for urban societies is not only for forest products needs but also for the role played by these forests in relation to environmental hazards in dry lands areas and this may necessitate conservation and development in urban forests.

However, the forest resources in Khartoum State are declining in area cover and volume stock (Elhadi 2005; Khairy 2003). Not only are the natural stands cleared, but also the urban forests plantations of the green belt were completely removed for urban expansion.

Table (5.4) Wood fuel and other biomass consumption by states as percent of Total northern Sudan

State	Firewood	Charcoal	rank	Alternatives
Khartoum	4.6	30.9	1	0.18
Gezira	2.2	22.5	2	31.75
Sennar	3.1	8.4	3	0.6
North Kordufan	8.1	5.7	4	0.31
White Nile	4.2	5.6	5	10.23
Kassala (KA)	5.7	4.2	6	0.07
Red Sea	1.7	3.7	7	0
Southern Darfur	18,2	3.5	8	45.24
Gedaref (GD)	3.1	3.5	9	4.85
Blue Nile (BN)	4.2	2.2	10	0.31
River Nile	3.6	2.0	11	0.01
West Kordufan	6.9	2.0	12	0.14
South Kordufan	3.6	1.8	13	0.63
North Darfur (ND)	11.9	1.7	14	0.07
West Darfur	15.9	1.3	15	2.77
Northern	3.2	1.0	16	2.8
	100	100		99.92

Source: Wood fuel consumption survey 1994.

Tables (5.2, 5.3, and 5.4) indicate that Khartoum as an urban area is characterized by high wood energy consumption and contributes negatively to forest development in the surrounding of Khartoum or in remote areas from where wood is transported to Khartoum. The main source of wood energy supply for Khartoum

is in the remote areas including Kassala, Gedarif, Sennar, Blue Nile and Upper Nile.

5.4 Urban Trees and Forests in Khartoum State

Forest surveys based on remote sensing images taken 1989 and 2000 Figure (5.1) indicated the deforestation taking place in the surrounding of Khartoum resulting in decrease of forest cover.

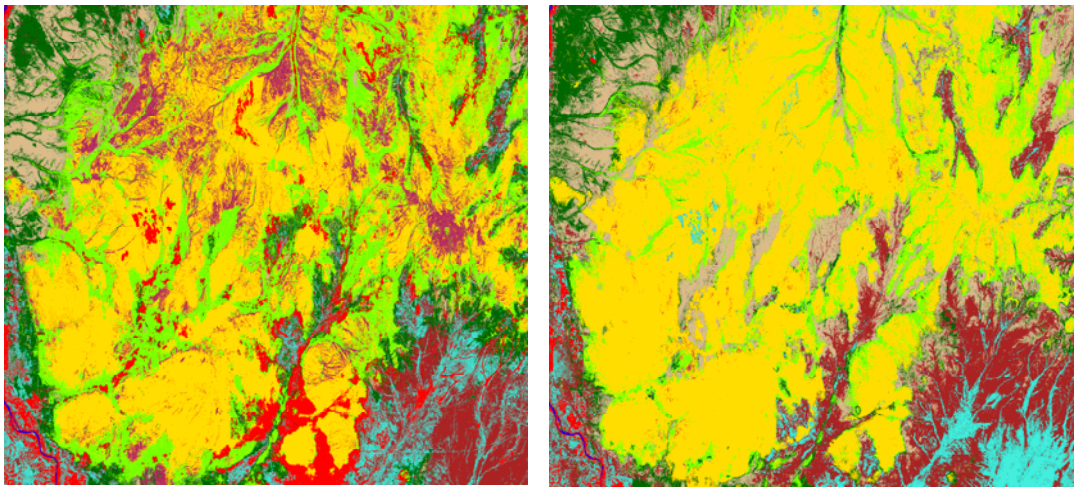

Figure 5.1 Remote sensing images for Khartoum eastern areas: left (1989); right (2000)

Trees and forests in urban areas and urban surrounding are not receiving the attention they need and deserve. As a result they have been disappearing at alarming rates. Khartoum is experiencing a decline in natural tree cover of its surrounding peri-urban areas as shown in figure (5.1). Most of the vegetation seen in figure (1) left does not exist in figure (1) right. Plantation forests like the green

belt and natural relics have been completely cleared to provide for agricultural development or urban expansion.

5.4.1 Planted and natural Trees and Forests in Khartoum State Urban Sites

Urban forest is consider as a collection of trees that grow within a city, town or a suburb including any kind of woody plant vegetation growing in and around human settlement in urban areas. The natural environment of urban areas can be improved through the planting and care of trees that make up our urban forests.

Knowledge about trees and forests, found in Khartoum urban and peri-urban areas, whether with regards to what kinds of trees are or the effect these trees have on the urban environment and the services and well-beings of urban societies, is very limited. Measurements and inventories of urban forests resources are necessary to facilitate evaluation of how urban developments influence forests and trees within the areas of urbanization.

Surveys conducted by the present study indicate that a diversity of tree species exists in Khartoum urban and peri-urban areas. Seven sites were classified and surveyed and the planted and natural tree species growing on these sites were identified and recorded in the list. Trees are found to exist in two types: Planted and natural forms. Both types are found on the seven sites. Seven codes were used to identify seven levels of relative abundance for each tree species on each site. Each code was assigned numerical number. Table (5.5) presents the codes with numbers against each one.

Table (5.5) Codes and numbers for relative abundance of tree species

Code	Number
Very abundant	6
Abundant	5
Average	4
Common	3
Rare	2
Very rare	1
absent	0

The numerical values of codes facilitated ranking of the tree species, existing in Khartoum, in descending order taking the total sum of codes values against each tree species. The sites are grouped in two categories: Group One for trees (along street, inside institutional quarters and inside home yard) and Group Two for trees growing (in parks, on-farm, along drainage lines and inside grave yards). In each of the two categories, tree species were group as planted or natural. Group one category was presented in table (5.6) and group two categories were presented in table (5.7).Category one presented in table (5.6) shows the ranking of planted tree species (group A) and the natural ones (group B).

Table (5.6) Tree species in Khartoum urban areas identified and ranked in relative occurrence on sites of Group One

Group	Species	Street	institutes	home	record
A	Neem	6	5	6	17
	Mahogany	6	5	3	14
	kafur	4	4	3	11
	ficus	3	4	4	11
	Dte palm	4	3	3	10
	Beltafrum	2	3	2	7
	Dig elbasha	3	2	2	7
	bongamia	3	2	2	7
	Tamr hind	2	3	2	7
	lmRoyal pa	1	2	3	6
	Lashoka	1	3	2	6
	Brazilia	2	2	2	6
	Gold more	2	2	1	5
	arkaweet	1	2	2	5
	Damas	2	1	1	4
	Cassia	1	2	1	4
	Kitir	1	1	1	3
B	mesquite	7	5	4	16
	Dom	2	2	2	6
	Higleeg	2	2	1	5
	Sidir	2	2	1	5
	Seisban	1	2	1	4
	Sunt	1	1	1	3
	Gudeim	1	1	1	3
	Aradeib	0	1	1	2
	Haraz	0	1	1	2
	Talih	1	1	0	2
	Usher	1	1	0	2
	Arak	0	1	1	2
	Tundub	1	0	0	1
Total	30specie				

Table (5.6) shows that 30 tree species grow on the three sites of which 17 species in planted form, (group A), and 13 species in natural form, (group B). Neem

(*Azadiracta indica*) dominated the list of planted tree species of Category One, recording the value of 17 as a measure of occurrence. Mahogany (*Khaya senegalensis*) marked second recording 14 while Kafur (Eucalypts) and Ficus share the third position by recording 11 each and Date Palm takes the fourth position by recording 10 points. The list continues in descending order for the rest of planted tree species category (A) as shown in table (5.6).Table (5.6) also shows the occurrence of the tree species of the naturally growing type, identified to grow along streets, inside institutional quarters and inside home yards found as occurring in common or rare order when each site is considered separately.

Although Mesquite indicates the most abundant species at the three sites, it is considered as an undesired invader. Table (5.7) contained the same list of 17 planted tree species (group A) and 13 natural ones (Group B) but have changes in species ranks as compared with table (5.6). Neem (*Azadiracta indica*) and Kafur (Eucalypts) are the most abundant species on parks, farms, drainage lines and grave yards. They share the top position on the list of planted tree species. Date palm, Mahogany (*Khaya senegalensis*) and Kitir (*Acacia mellifera*) take the third, fourth and fifth positions respectively. The rest of tree species on the list continues in descending order along table (5.7).

However, planted tree species show rare occurrence on drainage lines and grave yards. Table (5.7) shows that Neem (*Azadiracta indica*), Mahogany (*Khaya senegalensis*), Kafur (Eucalypts) and date palm constitute the dominant planted tree species on parks in urban areas. With respect to on-farm site, planted kafur and kitir take the lead. On farm tree planting in the peri-urban areas is encouraged by land tenure in Khartoum State where 55% of farmers are land title holders (Elhadi 2005). In addition, development Project like FINNIDA working in Khartoum State (1981 – 1997) encouraged on-farm tree planting by seedling

distribution and provision of extension to increase awareness and enhance participation of farmers.

Table (5.7) Planted and natural tree species growing on sites of Group Two

Group	Species	Park	Farm	drainage line	Grave yard	record
	Neem	6	3	-	4	14
	kafur	3	6	2	3	14
	Date palm	2	5	2	2	11
A	mahogany	6	2	0	2	10
	kitir	0	6	2	0	8
	Ficus	3	2	0	0	5
	Tamr hind	2	3	0	0	5
	arkaweet	2	1	0	2	5
	Brazilia					
	Bongamia	2	1	0	0	3
	damas	2	1	0	0	3
	Royal palm	1	1	0	0	2
	casia	1	0	0	0	1
	beltufrum	1	0	0	0	1
	Dign elbasha	1	0	0	0	1
	lashuka	1	0	0	0	1
	goldmore	1	0	0	0	1
	mesquite	6	6	6	6	24
	dom	2	3	2	2	9
	higleeg	3	3	1	2	9
	sidir	3	3	2	1	9
	sunut	1	2	2	2	7
	tortilis	0	2	2	3	7
B	talih	0	2	1	2	5
	seisaban	1	2	2	0	5
	ushar	0	2	2	1	5
	haraz	1	1	1	1	4
	tundub	0	1	1	1	3
	Arak	0	1	1	0	3
	aradeib	1	1	0	0	2
Total	30 species					

Table (5.7) indicates that Kafur (Eucalypts) and Kitir (*Acacia mellifera*) dominated on-farm tree planting in Khartoum peri-urban, sharing the top position on these sites. This agrees with Elhadi (2005) who stated that Eucalypts and Kitir constituted the dominant tree species planted by farmers supported by FINNIDA Project (1981 – 1997) in Khartoum peri-urban areas.

Naturally growing tree species, on the other hand, are dominated by Mesquite as an invader showing the highest occurrence on all sites in Category Two Group (B). Excluding Mesquite as the most abundant tree species, then Dom (*Hyphaene thebeica*) Hegleeg (*Balanites aegyptiaca*) and Sidir (*Ziziphus spina-christi*) share the top position of the list of the naturally growing tree species. The list continues in descending order indicating rare and very rare occurrence of tree species on the four sites of parks, farms, drainage lines and grave yard.

Excluding Mesquite, there are 12 indigenous tree species distributed all over the urban and peri-urban areas of Khartoum State, existing along avenues, in institutions quarters, at home, in parks, on farm, along drainage lines and in grave yards. They regenerate naturally, growing spontaneously under unmanaged conditions.

Special consideration was given to the drainage line sites characterized by naturally growing trees. It was noticed that the stocking density along tree lines vary widely in spacing between trees as in the range of 5 – 6 meters on some sites and as wide as 20 – 30 meters on other sites. It is water availability that creates different conditions for natural regeneration and tree growth. On sites like irrigation canals and along the banks of rivers, dense tree lines are growing in various mixtures of species. Dom (*Hyphaene thebeica*), Sidir (*Ziziphus spina-christi*), Seisaban (*Parkisonia digitata*), are the most dominant while Talih (*Acacia seyal*), Higleig (*Balanites aegyptiaca*) and Sunt (*Acacia nilotica*) are available in variable numbers.

Grave yards constitute enclosures where natural regeneration is under protection and many indigenous trees find suitable conditions for regeneration and development. There are many land forms, in urban areas, enclosed by protective wires or walls. The conditions are similar to that under the grave yards where unmanaged land forms bear indigenous tree species in variable composition and size classes.

Any management that could be provided to the naturally growing trees, found on land forms like those on drainage lines or inside enclosures, will result in tree development that adds to the beauty of the urban landscape. What is required is the definition of the institutions or organizations to which that these forms of urban landscape belong. It is common to all these sites, where indigenous tree species grow, that no management is practiced to improve the regeneration and form of the growing trees.

The thirteen indigenous tree species growing naturally on different sites in Khartoum urban and peri-urban areas are more diverse inside Khartoum than the peripheries. Less number of species were reported to be distributed in the peri-urban areas and mostly replaced by Mesquite as it invaded unmanaged sites (Elhadi 2005).

5.4.2 Uses and benefits of urban trees and forests

Table (5.8) shows that some of forest products constitute the main benefits from tree including wood and non-wood products. The forest products presented in table (5.8) are not in fact harvested from trees existing in Khartoum urban areas. They are collected and transported from remote distances from east, west and central areas of Sudan but all of the products constitute important products for urban societies.

The present study recognized 13 tree species that grow naturally in Khartoum urban and peri-urban areas which are known to be producers of the valuable products listed in table (5.8).

Table (5.8) Uses and benefits from the species existing in Khartoum State

Species	fuel	food	medicinal	gum	cosmetic	oil	tannin	fibers
Date palm		√						√
talih	√			√	√	√		
Higleig	√	√				√		
sidir	√	√			√			
Sunt	√						√	
Aradeib		√	√					
Gungleis		√	√					
Dom		√	√					√
Neem						√		√
Kafur					√	√		
subag					√			

Wood fuel is the most important benefit provided by four indigenous species namely Talih (*Acacia seyal*), Hegleeg (*Balanites aegyptiaca*), Sidir (*Zyziphus spina-christ*i) and Sunut (*Acacia nilotica*). Food products, basically obtained from fruits and seeds, are provided by eight tree species. Fruits are usually consumed directly (date palm, Hegleeg, sidir, Aradeib (*Tamarindus indica*), Dom (*Hyphaene thebeica*). Fruits also constitute the raw material for soft drinks as from Aradeib (*Tamaridus indica*) Gudeim (*Grewia tennex),* Gunguleis (*Adansonia digitata*).

Forest products provided in raw material are important source for cottage industry. The leaves of Dom (*Hyphaene thebeica*) enter into cottage industries such as baskets, ropes, hats, food containers and others that can be good material for ecotourism. Products from fiber-based industries and other forest products also constitute a source of income for the majority of Sudanese people in the dry land whether these people are collectors or retailers.

The thirteen tree species recorded in tables (5.6 and 5.7) are found as isolated single trees growing in poor conditions. They do not belong to any systems of tree and forest management. They are all growing spontaneously as naturally existing trees receiving no protection or management. However, they are growing inside urban areas that qualify them for development, provided that they are included under management system of reserved trees and reserved forests. Hence these tree species may need some concern directed towards them to qualify them to contribute in provision of the benefits listed in table (5.8).

Tables (5.6, 5.7 and 5.8) are compatible and strongly linked. Table (5.8) provides a list of important forest products supplied to urban markets in Khartoum State. Tables (5.6 and 5.7) contain all the species that are the producers of the list of products recorded in table (5.8). This is a link that indicates that the indigenous species, growing on many sites inside or in the periphery of the urban areas, although existing as rare species they are potentially important. These rare tree species are potential producers of many forest products known to the societies in urban and peri-urban areas of Khartoum State.

With the exception of date palm that has recently attracted the attention of formal and private sectors, and excluding Neem (*Azadiracta indica*) and Kafur (Eucalypts) which are planted on large scale on many of the urban and peri-urban sites, not a single one of the list of tree species listed in table (5.8) is given due consideration for planting in any site of the urban areas. The survey of the present study did not record any of the species listed in Group (B) table (5.6) or Group (B) table (5.7) as a planted tree species in any of the seven sites in the urban areas. They all constitute spontaneous urban trees growing naturally under un-managed conditions. Yet these species are potential resources that need to be considered to be managed as urban resources.

The concern of nurseries management organizations in Khartoum State, particularly government and development projects nurseries has been directed towards preparation of seedling for few species including Neem (*Azadiracta indica*), Mahogany (*Khaya senegalensis*), Kafur (Eucalypts) that might justify the dominance of these species in the planting program.

FINNIDA Project and Forest National Corporation (FNC) distributed 6.571 millions of seedlings in connection with tree planting programmes conducted in Khartoum State during 1981 – 1997 (Table 5.9). The main species distributed to farmers through this programme included Kafur (Eucalypts) and Kitir (*Acacia mellifra*) as reported by Elhadi (2005).

Table (5.9) Seedling production and distribution by FINNIDA and FNC Projects 1981 – 1997 (numbers × 1000)

period	To farmers	To institutes	To schools	Total
1981 - 1997	2512	2673	1246	6571

Trees and forests are maintained by people at home, on-farm, at streets and by formal institutions at the institutes' yards, on parks and elsewhere on other urban sites because of the various physical and environmental benefits trees provide.

Tree planting for shade is one of the objectives for planting trees in urban areas in semi-arid dry conditions. On-farm shelter, provided by trees, is one of the perceptions of farmers in peri-urban areas around Khartoum. In addition to shelter, on-farm tree planting is perceived to improve the soil particularly when farms are put under rest period to allow trees to develop for a time that provides for nutrients and organic material to be added to the soil (Elhadi 2005). On-farm

tree planting in Khartoum area is reported to be of use for animals in form of fodder.

5.5 Demography in the selected area

One of the possibilities for developing urban forests and trees is through community participation in addition to provision of incentives such as seedlings distribution and extension services. Investigation into aspects of community participation necessitates identification of urban societies and definition of target groups to be selected.

5.5.1 The target groups

The stage wise sampling was used for sampling procedure in the present study. Umm-Duruman locality was selected to represent Khartoum State. Random selection used the table of random digits which resulted in the selection of quarters and villages. From all quarters of Umm-Durman, four quarters were selected to represent the urban society (Table 5.10).

The peri-urban societies in Umm-Durman locality were represented by the four villages selected randomly (Table 5.10). The target groups were represented by the residents (households) of the four quarters and the four villages in the study area as well selected randomly (Table 5.10).

It is these target groups that reflect the perception of the urban communities whether inside the Umm-Durman urban societies or in the village peri-urban societies.

Table (5.10) Target group in the study area

quarter / village	No. of Respondents	Percent of total

Al-Abassia	125	35.7
Baet-Almal	64	18.3
Al-Shohada	32	9.2
Al- Arda North	25	7.2
Gibal-Ataina	40	11.4
Al-Migdab	39	11.1
Goz ebrahim	20	5.7
Aid Abouzed	5	1.4
Total	350	

5.5.2 Respondent age distribution

Table (5.11) shows that 29.8% of the respondents are in the age group > 40 years, 24.6% are in the age group of 18-24, 24.1% are in the age group of 25- 30 and the least are in the age group 31-40 indicating 21.5%. Taking the case of each age-group separately, most of the respondents are in the age-group over forty years old. Most important is that the majority of the population is in the collective age group younger than 40 years, constituting 70.2 % of the total. This is the age of active participation in tree planting activities.

Table (5.11) respondents' distribution with respect to age

Respondent age	Frequency	Percent
18-24	86	24.6
25-30	84	24.1
31-40	75	21.5
>40	104	29.8
Total	349	100.0

Age is very important factor in designing and implementing programmes. Each stage of age has its own characteristics and requirements, even the same age group persons have different desires and interests, and each comes from different home and country and has different attitudes, beliefs, interest and capabilities.

5.5.3 Persons in the family in group age 15-18

Table (5.12) presents the respondents statements in reaction to the question if they have member of family in age group 15-18 years. Respondents constituting 61.7% said that they have and 38.3% said that they do not have. The young persons within this age group have the desire to participate and they usually accept supervision and leadership from the elders. They always want to gain knowledge, experiences and skills in planting trees. An extension programme can be developed to encourage this segment of the societies to take an active role in developing urban forestry and to participate in awareness raising about their environment.

Table (5.12) persons in the family within age group 15-18

Respondent answer	Frequency	Percent
Yes	213	61.7
No	132	38.3
Total	345	100.0

5.5.4 Respondents' sex distribution

Gender defines the socio-cultural roles, functions and characteristics of men and women as they relate to each other within a specific socio-cultural context

Gender issues necessitate investigation on sex structure in order to provide information on sex distribution in urban sites. Table (5.13) shows the respondents sex distribution. The majority of respondents were males constituting 54.4% while females were 45.6%.

Table (5.13) Respondents 'sex distribution

Respondents ex	Frequency	Percent
Male	190	54.4
Female	159	45.6
Total	349	100.0

5.5.5 House tenure

Table (5.14) shows that 84.5% of the respondents owned their own houses, and 15.5% are living in rented houses. Ownership is a factor that influences the residents' feeling of stability, relief and strong relationship with their society. Such feeling is a driving force towards and, taking an active participation in tree

planting and the environment protection. So they can be mobilized and encouraged to participate in the tree panting activity and became more capable and responsible citizens.

Table (5.14) House tenure in Umm-Durman

House Tenure	Frequency	Percent
Rented house	54	15.5
Owned house	294	84.5
Total	348	100.0

5.5.6 Education

Table (5.15) shows that the majority of respondents have education at secondary school and university level recording 37.2% each while the elementary school has 15.8% and 4.3% are post graduated. However, the illiterates constitute only 5.4%. Table (5.15) indicates high level of education within urban and peri-urban societies reaching up to 94.6 % for all levels, and only 5.4 % are illiterates.

This agreed with the information on literacy and education obtained from the last census (1993), that Khartoum state showed the highest literacy rate. In Khartoum State there are no large distances that separate the urban from the rural areas. Thus the rural students can have their education in the urban areas. This situation gives a wide chance to develop an active and intensive extension programmes to make use of these resources in developing the conceptions and the understanding of urban forestry and their potential role particularly the environmental related issues.

Table (5.15) Respondents educational level

Education level	Frequency	percent
illiterate	19	5.4
Elementary	55	15.8
Secondary	130	37.2
Graduate	130	37.2
Post graduate	15	4.3
Total	349	100.0

Education is usually seen as an aspect affecting society by socializing individuals at schools and other levels. Education not only provides scientific and technical skills, but also provides motivation and social support.

Educational system in the Sudan has undergone considerable changes during 1970 to 1991. It comprised different levels including pre-elementary, eight years elementary school, three years secondary school and 4 – 5 years at university.

Surveys and interviews indicated that almost all faculties of agriculture, forestry, animal production, natural resources and environmental studies at the universities in the Sudan have courses that can accommodate agroforestry and other forestry related issues (Elsiddig 2002). This may indicate the possibility of developing community forestry programmes to support the development in UPF.

5.6 Urban trees and forests IN Umm-Durman Locality

Umm-Durman is an old city and has many institutions since late 19th century. Tree planting was adopted long ago as indicated by existence of very old trees.

5.6.1. Presences of trees in and around the respondents' houses

Table (5.16) shows that most of the respondents (43.7%) reported that they have planted 1 – 5 trees inside home yard and in front of their homes while (22.6%) of the respondents have planted more than 5 trees. The rest of the respondents (33.7%) have no trees at home.

It appears that according to table (5.16) the majority of respondents, constituting (66.3 %), confirmed the existence of trees in their household area either inside the home yard or outside. This total number of respondents is composed of two group; one group are those who have small number of trees planted equal to less than five tree at home and the other group have more than 5 trees.

Even those who have 1- 5 trees they rarely have more than two because of the limited area. Most of the quarters of the study area in the urban sites are old homes where the family is extended and hence the houses are becoming small and shared with more than one family. This situation of extended families is created as a result of high values of houses rent which constitute financial constraint to the family members and would have no alternative than extending the families in the same house.

Table (5.16) Trees in and around houses

Number of Trees Plant	Frequency	Percent
No Trees	188	33.7
1-5	153	43.7
>5	79	22.6
Total	350	100.0

5.6.2. Constraints hindering people from planting trees

Figure (5.1) showed that the majority of respondents (50 %) live in houses characterized by small area. Small area of houses' yard constitutes the main constraint facing most of the respondents and created an obstacle for planting trees.

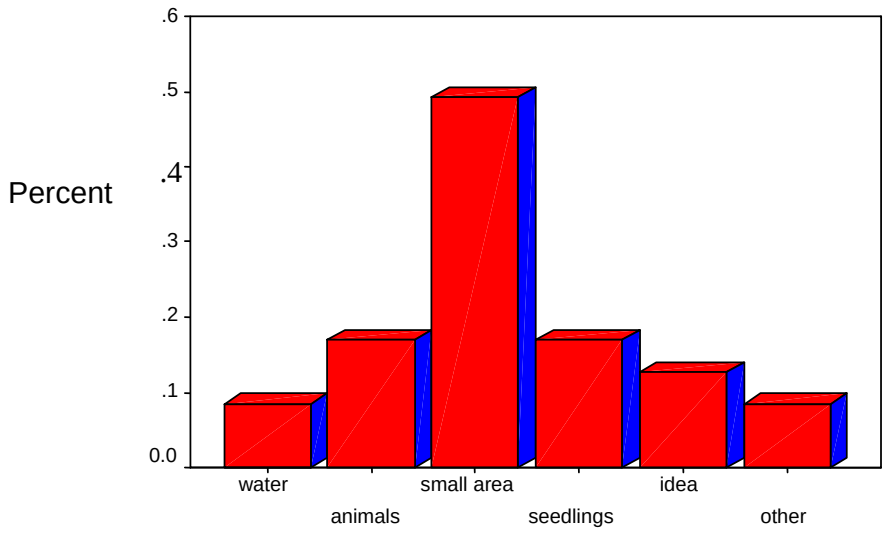

Figure (5.2) constraints hindering tree planting

A considerable percentage (20 %) stated that they face problems in keeping their animals because of the limited space at their homes. Other respondents (20 %) have difficulties in planting trees because they have difficulties in having seedlings. Also 15 % of the respondents are not aware about the techniques of tree planting. Water is an important factor for the success of tree planting but was mentioned by only 8.0 %.However, there are many small problems mentioned by (9%) of the respondents as constraints. These included perception of some respondents that trees harbor mosquitoes and also some of the respondents feel

that the prices of seedlings are considered as obstacle and also for some respondents there is limited time for caring about trees. Women said that they are busy with looking after children and could not compromise for caring about trees. For some households, the house ownership represents another constraint particularly those who rent houses.

Most of the constraints that are grouped under others seem to be minor when each is considered separately but collectively constitute important reasons for making the relation of respondents to trees as not strong. This critical economic condition is considered a negative impact in developing urban forestry and hindered respondents from planting trees. It was observed that most of the respondents have plants grown on pots. This reflects that some people appreciate the aesthetic value of greening and they want to plant something but limited space is a limiting factor.

5.6.3. Comparison between constraints hindering people from planting trees in urban and peri-urban area

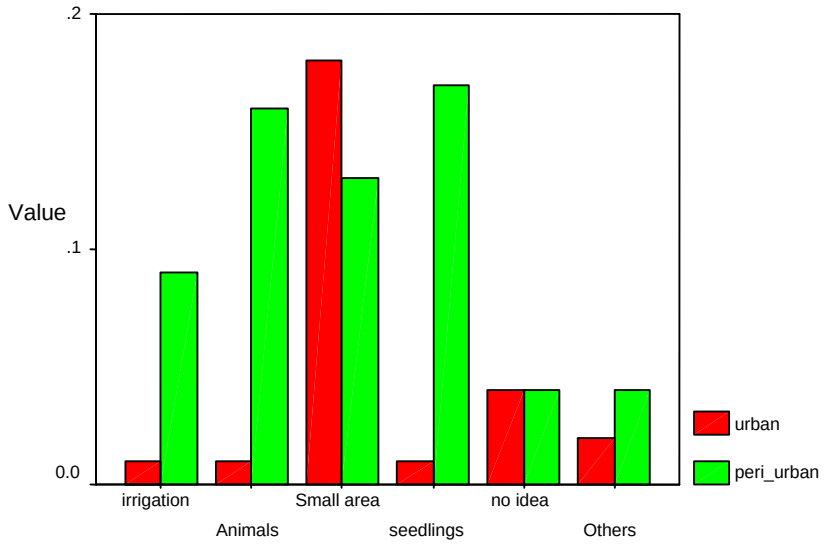

Figure (5.3) constraints hindering tree planting in urban and peri- urban

Figure (5.2) showed that 50% of the respondents live in houses characterized by small area and figure (5.3) of the comparison indicates that small area is a constraint for respondents in urban area more than peri-urban. Limited house yard area is a result of urbanization phenomena but should not be a big problem in developing urban and peri-urban forests trees can be planted in other locations such as open spaces, streets, schools and or any suitable site. Stray animals are constraint for people in peri- urban more than in urban that because people in peri-urban raise animals and find difficulties in protecting trees while in urban people are very rare raise animals also laws and the local orders with respect to the stray animals are working effectively and reduce the damage by animals.

Shortage of water is a constraint for some areas in peri-urban more than urban area, it discourage people from planting trees and gives low priority and negative attitudes to words trees. In this situation people need to manage water properly for example waste water can be used for watering plant and selection of suitable species for the concerned site is required.

5.6.4. Sources of seedlings

Urban tree planting requires preparation of seedlings. Figure (5.4) represents the supplies of seedlings which rely on three sources. It is clear that most of the respondents (60%) get seedlings from private nurseries. Few respondents (15 %) get seedlings from Government nurseries. Other sources mentioned to collectively constitute (25 %) included gifts provided by public committee. Still some sources relied on raising seedlings at home. Some of the respondents mentioned that the trees at their homes grew naturally.

From figure (5.4) there are wide differences between the numbers of respondents who get seedling from the available sources of seedling supplies. The number of respondents who get seedlings from private nurseries is more than twice that number of respondents who get seedlings from government nurseries in spite of the fact that seedlings prices at government's nurseries are subsidized. That may mean that private nurseries are more attractive to the people for reasons known to them or may be more accessible to people.

The findings in the present study is in agreement with the reports and general observations that the private nurseries are in increasing number during the last years in Khartoum state and are getting nearer to the public than government nurseries. Increasing number of nurseries will help in dissemination of the culture of greening and seedlings will become more available and with reasonable prices as well as they are source of income.

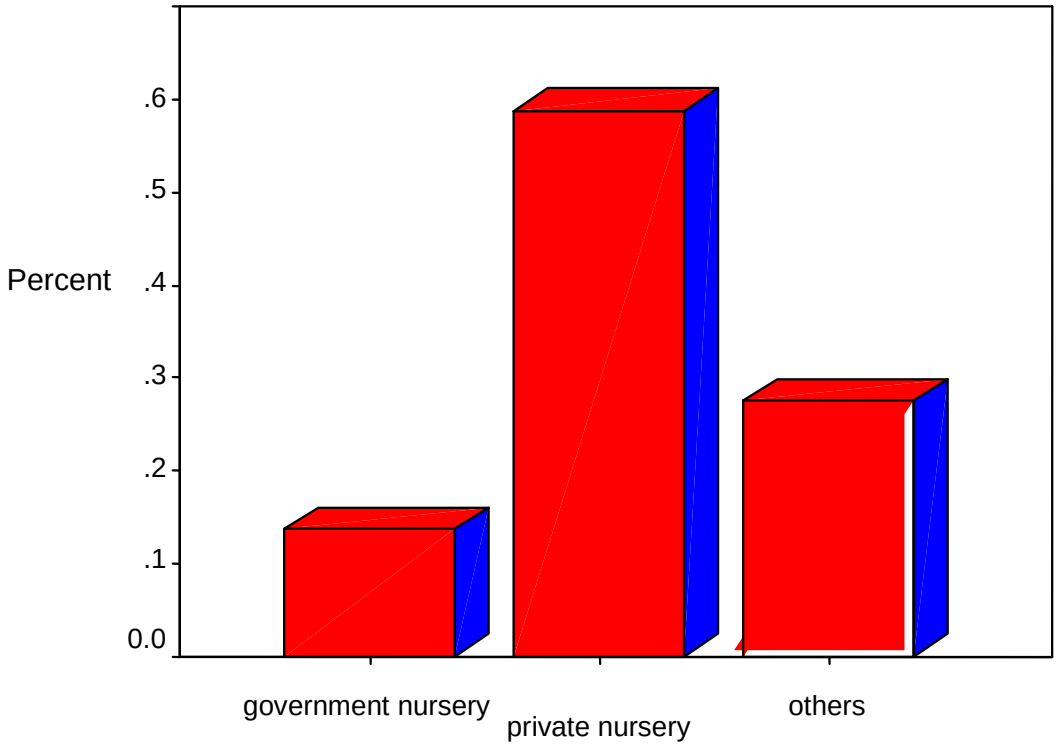

Figure (5.4) sources of seedlings

5.6.5 Nurseries available for respondents

In response to the question about the existence of nurseries in relation to respondent's homes, the answers were presented in table (5.17) indicating that 72.3% of the respondents said that there are no nurseries near theirs homes. Only 27.7% said that there are nurseries near them (Table 5.17). This indicates that the distribution of nurseries is not even over the area and that people go to nurseries through variations of distances. However, the fact that 66.3% of the target groups planted trees (Table 5.16) and that 60.5% of those who planted trees get seedlings

from private nurseries may mean that distance is not an obstacle for those people to plant trees.

Table (5.17) nurseries available for respondents

Respondents	Frequency	Percent
Yes	96	27.7
No	251	72.3
Total	347	100.0

5.7 Respondents' participation in tree planting activity

Figure (5.5) shows the respondents participation in the different stages of tree planting activity. Most of them (60 %) participate in the preparation for tree planting in the form of digging holes. Planning and co-ordination with the institutions or the bodies organizing the programmes constitutes 20 %. Some of the respondents (10 %) participate in protection of the trees by making fences or guarding means. Few of the respondents (7 %) take part in the campaign for awareness raising process in the area. Very few
(3 %) participate in other processes such as follow up, cleaning and transporting of seedlings.

Although people contribute in various forms towards tree planting activities, yet people are not well organized in the tree panting programmes. Most of them are not integrated in planning process. More efforts and attentions are given to preparation stages and limited efforts are directed to other activities like campaigns. The activities directed towards awareness raising seem to be very important particularly towards women and children who may represent the

important part of the respondents in relation to tree planting. In many cases, lack of awareness about tree planting, caused the failure of the programmes and complete lost.

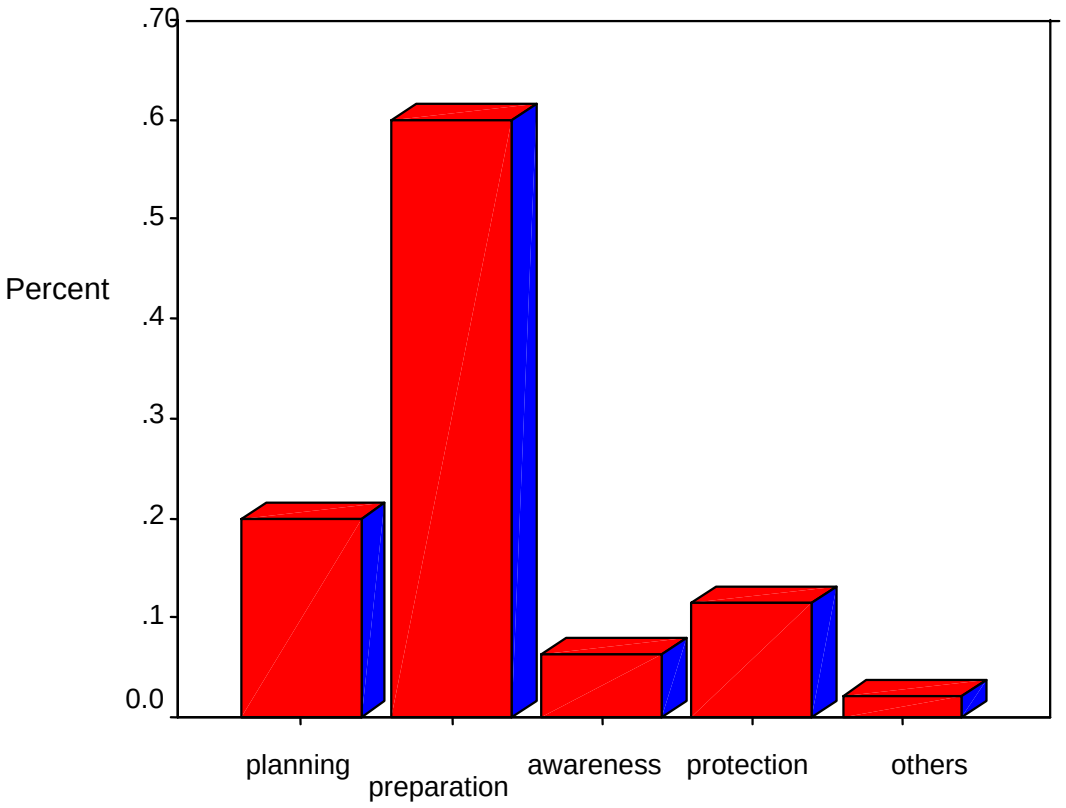

Figure (5.5) respondents' participation in trees planting

5.8 Respondents' perception towards trees cover

Evaluation of the status of tree cover situation as perceived by the people is very important to reflect the extent of peoples, awareness about existence of trees with time.

5.8.1 The status of tree cover in Umm-Durman presently and in the past

Table (5.18) indicates that 69.2% of the respondents stated that the tree cover in the area is in a better condition and in increasing rate than in the past but 30.8% of

them think it is in decreasing. The arguments of those who have the perception that trees cover is increasing have the justification linked to increasing willingness and interest in tree planting in addition to their understanding that there is competition between people for planting trees in the different quarters.

Table (5.18) condition of tree cover in the present

Respondents' answers	frequency	percent
Increasing	236	69.2
Decreasing	105	30.8
Total	341	100

5.8.2 Reasons for increasing tree cover

Figure (5.6) presents the distribution of respondents with respect to the reasons for increasing tree cover in Umm-Durman urban and peri-urban areas. The majority (67 %) of those who perceive increased tree cover stated that the main reason is related to increasing awareness about importance of trees. Some of the respondents (12%) think that seedlings become more available and easy to get. Government care comes in the third rank as perceived by 9%. Some respondents (7%) mentioned other reasons including the interest of some of them for rehabilitation of the quarter, interest of people for beauty of the landscape, efforts of previous generation in tree planting in addition to the need for shade.

Very few of the people (5%) think that NGOs such as students union have tree panting programmes in the area. This emphasized that all these reasons particularly that concerned with raising of people awareness as preparatory steps before starting tree planting programmes are important for tree planting success. It supports the sustainability and improving tree cover. Also respondents realized the

benefits of trees, need for shade or beautification encouraged some people to plant trees.

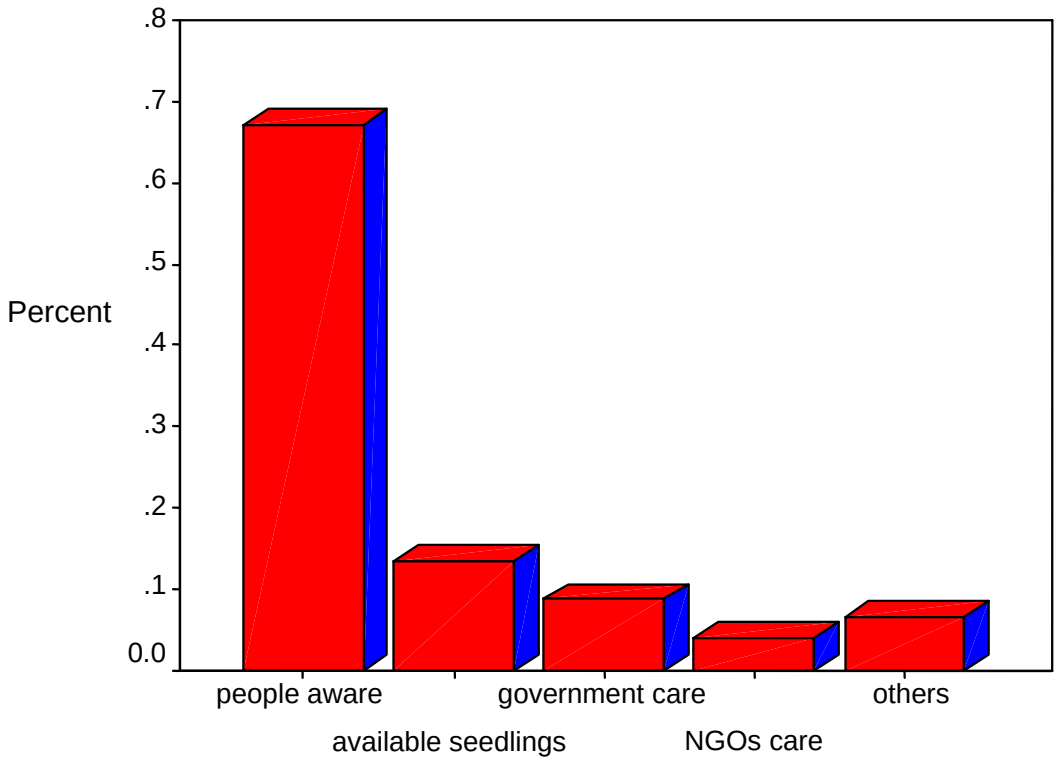

Figure (5.6) Reasons for increasing tree cover in Umm-Durman area

Peoples' high awareness about the need for tree planting coupled with their high level of interest (Table 5.19) constitute major driving forces towards the success of the activity and increase of tree cover. Table (5.19) shows that 76.7% of the respondents stated that people in Umm-Durman are interested in planting trees and only 23.3% think that people are not interested. The needs and the interests of people are very important factors for the sustainability of the programmes. So surveying of the area before starting tree planting programmes is important to examine whether the people are interested and they have the will to participate in tree planting and to conserve the trees for long.

Table (5.19) Interest of people in trees planting

Respondents answers	Frequency	Percent
Interested	257	76.7
Not interested	78	23.3
Total	335	100.0

5.8.3 Comparison between purposes for planting trees in urban and Peri-urban area

People have different purposes for planting trees according to the needs of the community. People's needs, opinions and preference should be incorporated into planning and management process. Satisfying the needs of community will help in the development of urban and peri-urban forests.

Figure (5.7) shows the different purposes for planting trees in urban and peri urban. People in urban area plant trees mainly for shade and decoration more than people in peri-urban area. While planting trees for fuel is the purpose for the peri-urban society more than urban society. Fruits are more appreciated by the peri-urban society some time fruits use for feeding animals. Income is not recorded as a purpose for respondents in both societies. Other values appreciated by the urban society are the environmental role of trees and some consider tree planting as a hoppy.

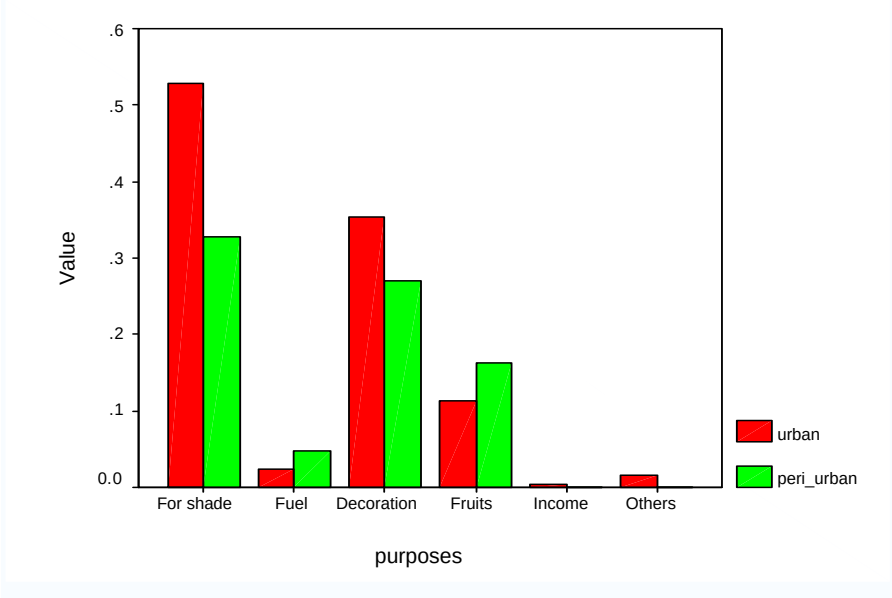

Figure (5.7) Uses of planting trees in urban and Peri-urban area - comparison

Values of appreciating trees benefits are differ in the two societies people in peri-urban used trees for fuel as fire wood more than people in the urban this compatible with table (5.3). In spite of shifting in energy consumption towards alternatives at urban and peri-urban areas yet the needs for wood energy will continue in peri-urban area.

5.9 Extension

Extension service is a mechanism through which awareness raising among people could be made possible. Extension activities all over the country enhancing community mobilization towards involvement into natural resource management. The creation of the forestry extension unit was seen to be one way of raising moral within the forest service by giving it an alternative approach with which to work.

5.9.1 Extension agents and environmental societies

When the respondents were asked if there are forest extension agents or environmental societies and NGOs or even person who offers an advice or support in the field of tree planting, 84.4% answered that there was no any agent who provided extension services while only 15.6% said that there were extension provision (Table 5.20). This indicates the absence of extension work or the existence of NGOs like environmental societies that provide extension services at the level of the quarters. Generally speaking, extension in urban forestry is very weak. Practical approaches are yet to be worked out in order to reach and involve citizens, especially the poor.

In spite of the limited extension service concerning awareness raising about tree planting (Table 5.20), and the limited participation of people in the campaign for awareness raising concerning tree planting (Figure 5.5) yet people are aware about the importance of tree planting (Figure 5.6) and that people have the interest to plant trees (Table 5.19). These findings indicate that there are some factors contributing to increasing the willingness of people to plant trees. It is expected that people positively influence each other by diffusion of information concerning tree planting. Also there may be some positive influences on people resulting from programmes of other media like television and radio or influences resulting from increasing public activities towards greening of urban centers.

Table (5.20) extension agent or environmental society

Respondents Answers	Frequency	Percent
Yes	53	15.6
No	286	84.4
Total	339	100.0

5.9.2 Extension activity in the quarters and in the villages

Table (5.20) indicates that 15.6 % of the respondents who confirmed the existence of extension agent or environmental society and or provision of extension service, 63.5% of them said that they had assistance and support in form of technical advice such as how to plant trees, select suitable species in addition to supply of seedlings.

Table (5.21) extension activity

Respondents Answers	Frequency	percent
Yes	33	63.5
No	19	36.5
Total	52	100.0

On the other hand, 36.5% of the respondents answered that there was no support received. The presence of the environmental societies and extension agents or even local people trained in the field of forestry or environment, can be effective and capable to support forestry programmes and hence develop the urban forestry. However, the service is limited, may be because of the limited number of extension agents

5.10 Assistance needed to promote tree planting

Development of tree planting programme requires satisfaction of needs assistance and provision of incentives that encourage people to adopt planting of trees and attend them whether in private areas like homes or on formal yards like government institutions. Figure (5.8) reflects the respondents' distribution with regards to the needs for motivations to promote tree development and

encouragement of respondents to participate in forestry activities and programmes execution in their areas.

The majority of respondents (70 %) mentioned that they need to be supplied with seedlings. Some of the respondents (30 %) mentioned that they need training in nursery establishment and tree planting techniques. Considerable number of respondents (28 %) needs awareness raising particularly at peri-urban areas. Few of the respondents (8%) mentioned collective factors, that there are other needs such as extension agent, active programmes, nursery establishment, and incentives in term of money and material for nursery. Some have problems for which they need help or advice. Some villages have problems of water availability; they sometimes buy or bring it from distant wells. In other villages there is problem with the soil.

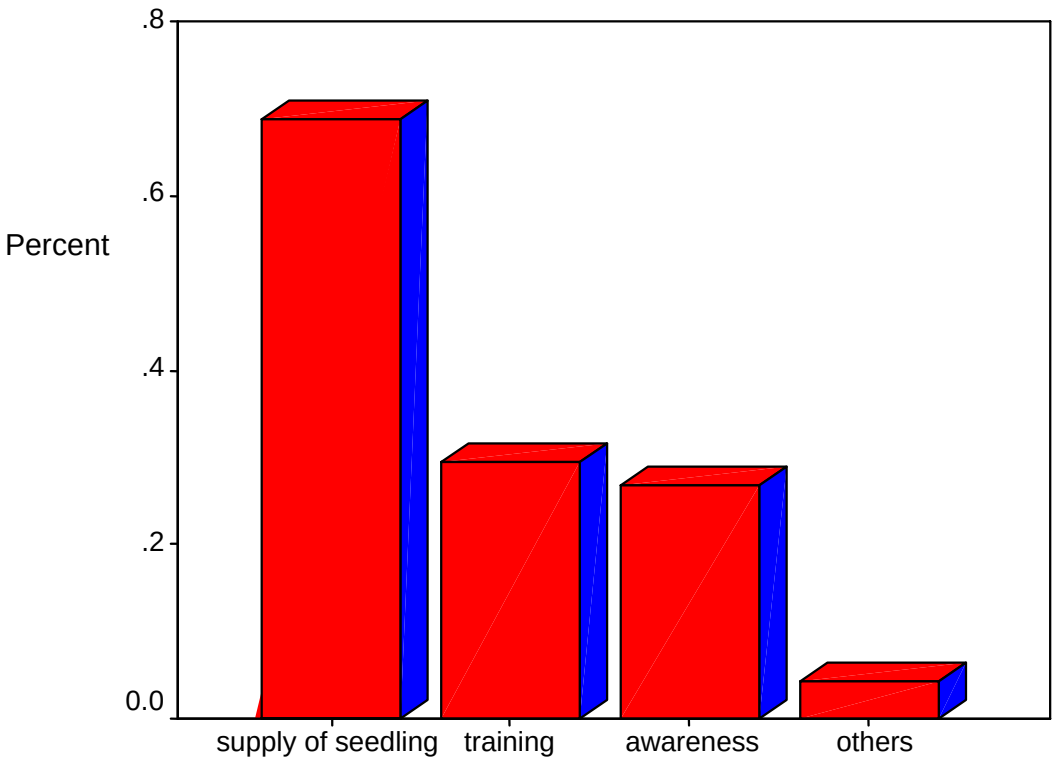

Figure (5.8) respondents' distribution with respect to assistance needed for promotion of tree planting

5.11 Responsibility about trees planting in urban and peri-urban areas in present and in the past

Management of trees in urban and peri-urban areas is necessary in order to achieve development and sustainability. The concepts of urban forests management puts responsibilities in the hands of various stakeholders to contribute in urban forests development. Urban forestry is practiced by municipal and commercial arborists, foresters, environmental policymakers, city planners, consultants, educators, researchers and community activists.

The respondents were asked about whom they think should be responsible about carrying tree planting activities in the quarters, villages, and or streets in the

present and who was in the past. Figure (5.9) shows that majority of respondents (48.5%) think that citizens should have the initiatives to carry this responsibility at the present time. A considerable number (37%) think that public committees should be more suitable to be responsible for this job in present. A third group of respondents representing (23%) stated that this is should be the responsibility of the government at the present time. Few respondents (11.5%) think that NGOs can be responsible at present. Very few respondents mentioned that some bodies like teachers are suitable for undertaking the responsibility while some think that the work must be done by the co-operation of all these bodies and yet some think that the national service can play an active role in this field. These last groups collectively constitute (4%).

Considering who was responsible about tree planting in the past, the majority of the respondents (47%) stated that citizens were themselves leading the activities of planting trees at theirs homes and around. (25.5%) of the respondents said that the government was showing responsibility and used to send officials to observe the situation of trees planted at homes and in front of the house. Others (14%) stated that public committees were responsible. A few of the respondents (8.5%) have the opinion that local organizations like village or quarter committees assumed responsibility about tree development in the area. Very few respondents (10%) mentioned that they did not know.

Figure (5.9) indicates that the people in the urban and peri-urban societies are concerned and interested to follow up how tree planting responsibilities are distributed. The majority believes that citizens are playing or played significant roles in tree planting whether in the present and at the past.

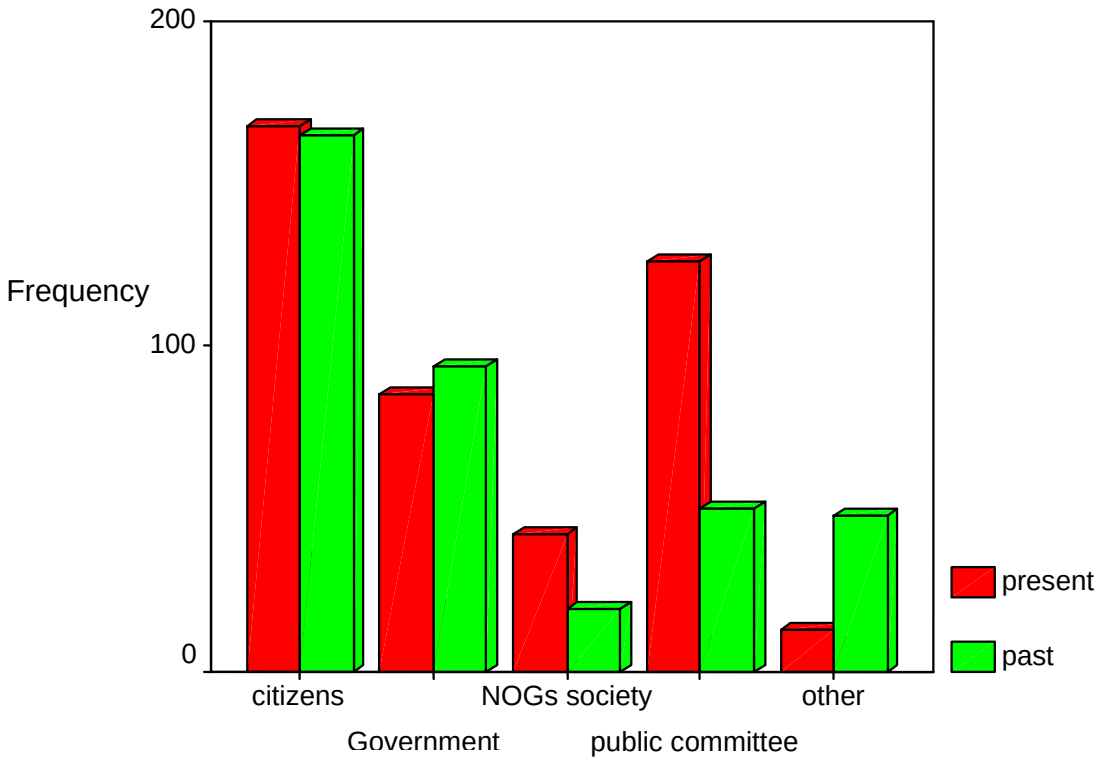

Figure (5.9) assessment of tree planting responsibility in the past and in present

Comprehensive urban forest management must be centrally authorized, vested in a single organization, such as a city forestry department, with responsibilities for both direct and indirect management of all sites of urban forests. That may mean that on government lands, the city forestry authority exercises direct management that ensures compatibility of trees with the urban environment while on privately owned sites the management takes an indirect approach, mostly through cooperation and educational efforts (Grey, 1996). Accordingly, the role of government and NGOs mentioned in figure (5.9) may be able to adopt such approach of collaborative efforts with the citizens that constitute the majority of people concerned with tree planting.

5. 12 Relationship between categories characters and some practices

In the coming discussions relationships between some categories characters and some practices and issues were carried using the Chi- square test to determine the extent of significance relationship between them.

5.12.1 Chi- Square Test

The Chi- Square independency test (contingency table test) is used to test if two methods of classification are statistically independent we are interested in testing the hypothesis that the two methods of classification are independent. If we reject this hypothesis, we conclude that there is some interaction between the two criteria of classification.

5.12.2 Relationship between education and Participation

Chi- Square was used to test the significance of the relationship between the degree of participation and the educational level. The test shows there is no significant relationship (person Chi- square 6.702 and P. value 0.153> 0.05).

Education level of respondents is not affected the degree of participation in tree planting activities in other wards the educated persons and the illiterate one have the same response towards participation in trees planting activities. The aim of the education is to prepare individuals to act effectively in the society, and also education is a primary agent of transformation towards sustainable management, the educated person can easily mobilized and should be more positive in the community. Sudan government adopted a policy for improving education system in the country, and Khartoum state showed the highest literacy rate (last census 1993) .This category (educated people) should enhance their participation and hence the development of urban and peri-urban forests.

5.12.3 Relationship between education and interest

Chi-Square test shows there is no significant relationship between the respondents' interest in tree planting and the educational level (Person Chi- Square 6.797 and P.value .147>0.05).

Conservation of environment and trees planting is the responsibility of all society, it is a duty it is not a choice this concept need to be deeply rooted in the society to reach this concept hard work is needed especially among the educated person who has the response and the readiness to understand the linkage between the presence of trees and the healthy environment. So education should play effective role in increasing people interest and participation.

5.12.4 Relationship between respondent's age and participation

Chi-Square test shows there is no significant relationship (Person Chi-Square 1.381and P. value .710> 0.05).

From our observations during the survey old people in the household care about trees and more interested. Younger people supposed to be more active and have the desire to participate in tree planting activities especially the age under forty years.

5.12.5 Relationship between respondents' sex and interest

Chi-Square test shows that there is no significant relationship between respondent' sex and interest (person Chi-Square 0.261 and P. value 0.609>0.05).

From the result of the sex distribution (table 5.13) most of the respondents are male this might be due to most of the interviewer are male this result is not necessarily that interest in tree planting is linkage with sex.

5.12.6. Relationship between house ownership and degree of participation

From the Table (5.22) Chi-Square Test shows that there is significant relationship between house ownership and degree of participation (person Chi-Square 5.294 and P. value 0.021<0.05).

Respondents who owned their houses get involved and have the willingness to participate in tree planting activity (count 68 while the expected 61.7). Respondents who rented houses did not have the motivation to be involved. Ownership is an important factor in developing urban forests; ownership means stability and potentiality for sustainability.

Table (5.22) relationship between house ownership and participation

Participate * House Owner-Ship Crosstabulation

			House Owner-Ship		
			rented house	owned house	Total
Participate	yes	Count	5	68	73
		Expected Count	11.3	61.7	73.0
	no	Count	49	226	275
		Expected Count	42.7	232.3	275.0
Total		Count	54	294	348
		Expected Count	54.0	294.0	348.0

5.13 Comparisons between different issues with regard to urban and Peri- Urban area

Characteristics and structure of the society in urban area and peri-urban area are not the same. The following discussions explain the different issues and practices with regard to the two societies.

5.13.1. Level of participation

Chi- Square Test was used to test level of people participation in urban area compared to the level of people participation in peri-urban area. The test shows that there is significant relationship (person Chi-square 4.427 and P. value 0.035<0.05). People in peri- urban area have participated in tree planting activities more than people in urban area (count 29 while the expected 21.7 table 5.23).

This can be attributed to the nature of the society. The community in the peri-urban area is more or less homogenous than urban area it can be easily organized and motivated through its CBOs or its village leader.

Table (5.23) relationship between degree of participation and the area

area * Participate Crosstabulation

			Participate		
			yes	no	Total
area	urban	Count	44	202	246
		Expected Count	51.3	194.7	246.0
	peri_urban	Count	29	75	104
		Expected Count	21.7	82.3	104.0
Total		Count	73	277	350
		Expected Count	73.0	277.0	350.0

5.13.2. Location of the nursery

Table (5.24) relationship between location of the nursery to the respondents' houses in urban and peri-urban

area * Nursery Crosstabulation

			Nursery		
			yes	no	Total
area	urban	Count	92	152	244
		Expected Count	67.5	176.5	244.0
	peri_urban	Count	4	99	103
		Expected Count	28.5	74.5	103.0
Total		Count	96	251	347
		Expected Count	96.0	251.0	347.0

Table (5.24) the test shows that there is significant relationship (person Chi-square 41.400 and P.value 0.001<0.05). That nurseries are near to respondents' houses in urban areas compare to respondents in peri-urban areas that means people in urban areas can easily get seedlings than people in peri-urban areas (count 92 while the expected 67.5) .

From our observation during the survey the nurseries are concentrated in urban area, This result should be consider in the developing urban and peri-urban forests .Tree planting requires preparation of seedlings, seedlings are the most assistance requested by the respondents(figure 5.8) nurseries distribution should be under control of the concerned authority according to the need of the area and the owner of the private nurseries should be encouraged and given incentive in term of some assistance e.g. reducing taxes and bills of water to establish their nurseries in peri-urban area.

5.13. 3. Respondents' opinions about status of tree cover around them

Table (5.25) relationship between respondents' different opinions about status of trees cover around theirs area

area * Number_trees Crosstabulation

			Number_trees		
			increasing	decreasing	Total
area	urban	Count	175	66	241
		Expected Count	166.8	74.2	241.0
	peri_urban	Count	61	39	100
		Expected Count	69.2	30.8	100.0
Total		Count	236	105	341
		Expected Count	236.0	105.0	341.0

Table (5.25) Chi- Square test was used to test the relationship between different opinions of people in urban and peri-urban areas towards the status of trees cover around them. The test shows there is significant relationship (person Chi-Square 4.473 and P. value 0.034<0.05). People's opinions in urban area about trees cover is in increasing rate (Count 175 while the expected 166.8).

Sustainable urban development requires providing a healthy and sustainable living environment with basic services. A healthy and multifunctional urban green structure is one of the basic services to provide but most of these services concentrated in the center of urban area. Most of the institutions concerned about trees planting such as corporation of Khartoum development and Khartoum beautification Center and others concentrated trees planting activities in the center of the urban the opposite is in peri-urban area.

5.14 Organizations and institutions involved in developing urban and peri-urban forestry in the state

Management of urban trees will not succeed without willing support and cooperation of the people and coordination between all institutions and organizations involved in these activities. NGOs (international and national) played the role of facilitator who helps communities think over issues and situation and learn the different ways of organizing, maintain their environment and satisfaction for wood and non-wood products (Salih 2002).
The concepts of urban forests management put the responsibilities in the hands of various stakeholders to contribute in urban forests development (Grey, 1996).
Stakeholders concerned with development urban and peri-urban forests either government institutions(FNC) or non-government institutions (public committees). NGOs maintain some form of networking; the activity was seasonal and reactive to events. In 1997 legislation incorporate NGOs networking as a platform for a collective movement seeking to strengthen environmental institutions and good governance.

The following discussion reflects the views of some organizations, institutions and societies involved in and concerned with urban forests development.

5.14.1 Status of trees planting activity in the state according to the views of the responded organizations

Table (5.26) shows the different views of the organizations involved in trees planting activity. 32% of them stated that the situation is in improving process.

This agreed with the perception of the respondents table (5.18). 12% think the situation is not improving.24% mentioned that it is more or less is medium.Others32% stated that more efforts are needed. From the result the majority confirmed that the status of trees planting activities is improving.

Table (5.26) Status of tree planting activity in the state

Answers	Frequency	Percent
Improving	8	32.0
Not improving	3	12.0
Medium	5	24.0
More efforts are needed	8	32.0
Total	25	100.0

Phenomenon of trees planting can be attributed to different factors including increasing of people's awareness, proliferation of private nurseries, competitions between citizens and activity of some government institutions like Khartoum Development Corporation and National Public Service.

5.14.2 Implementation of trees planting in the state in the present according o the views of different organizations

Table (5.27) indicates the views of various interviewed organizations with regard to planting activities implementation. 28% of them stated that citizens are planting trees in theirs homes and around. While government institutions stated by 12%, private sector 12% and CBOs 20%. 28% think the activities in a collaborative form of different institutions.

Table (5.27) Tree planting programs implementation in the state

Answers	Frequency	Percent
Gov. institutes	3	12.0
Private sector	3	12.0
Citizen	7	28.0
CBOs	5	20.0
All answers	4	16.0
1,2&3	3	12.0
Total	25	100.0

Tree planting can be carried out by different agents, governmental and non governmental. Citizens or community are playing an important role in developing urban and peri-urban forests. The planting of trees in human settlement is not new; people plant trees though out history what is new is that, in some places, foresters and urban officials are considering a broader range of benefits from trees and green spaces and are beginning to try and quantify them.

5.14.3 Responsibility of tree planting in the future according to the views of responded organizations

92% of the organizations/ institutions think that proper management of urban and peri-urban forests requires presence of one body or agent to be responsible for tree planting activities. Few 8% of them think it isn't necessary table (5.28).

Table (28) Responsibility of tree planting in the future

Answers	Frequency	Percent
Yes	23	92.0
No	2	8.0
Total	25	100.0

Comprehensive urban forest management must be certainly authorized, vested in a single organization, such as a city forestry department, with responsibilities for both direct and indirect management of all sides of urban forests (Grey, 1996).

5.14.4 The agent that could be responsible for tree planting in the state in the future

The majority of organizations (48%) think that the most suitable body or authority that should be responsible for development, supervision, and coordination of the tree planting activities in the state is a government institution. CBOS stated by 40% and NGOs mentioned by 8%of them table (5.29).

Table (5.29) the agent that could responsible for tree planting in the future

Answers	Frequency	Percent
NGOs	2	8.0
Gov. institution	12	48.0
Community body (Comm. committee)	10	40.0

5.14.5 Involvement of community in tree planting programs

Table (5.30) shows that more than 90% of the organizations involve community in tree planting activities.

Table (5.30) involvement of community in the trees planting

Answers	Frequency	Percent
NO	1	4.0
Yes	24	96.0
Total	25	100.0

The involvement of community in a forestation programes is very important factor in conservation and sustainable management of forests. Urban forestry programmes can not and should not be carried out solely. Participatory approaches, now commonly being used in forestry projects in rural areas of developing countries, could well be adapted for use in urban areas. These methods ensure that the people themselves are involved in planning, managing and monitoring the progress of activities.

The management of urban forests on privately owned sites takes an indirect approach through cooperation and educational efforts. Accordingly, the role of government and NGOs is to facilitate support to the stakeholders in adoption of such approach of collaborative efforts with the citizens that constitute the majority of people concerned with tree planting (Grey, 1996).

5.14.6 Community participation in tree planting

More efforts are given to implementation stage and few are given to other stages table (5.31).

Table (5.31) Stages of participation in tree planting

Answers	Frequency	Percent
planning	1	4.0
Implementation	14	56.0
Monitoring	2	8.0
All answers	3	12.0
1&2	5	20.0
Total	25	100.0

Monitoring and care about trees are very important to guarantee the success of trees growth. Urban forestry is a practical discipline, which includes tree planting, care, protection, and the overall management of trees as a collective resource based on integration of efforts.

5.14.7 Coordination between the different organizations

Government should work with other entities in promoting and executing forestry activities. Partnerships must be develop with community groups, NGOS, research and academic institutions, private sectors and municipal entities.

Organizations interviewed stated that they do coordinate theirs programs with others mainly governmental institution particularly FNC.

Table (5.32) coordination of programs

Answers	Frequency	Percent
Yes	24	96.0
No	1	4.0
Total	25	100.0

5.14.8 Constraints hindering development in UPF according to the views of the different organizations

Table (5.33) shows the constraints hindering planting trees mentioned by those organizations. The major problem stated are technical constraints (irrigation, tree species, sits…etc) lack of fund, weak interaction with community and co-ordination respectively.

Table (5.33) constraints hindering development of UPF

Answers	Frequency	Percent
Coordination	4	16.0
Lack of fund	4	16.0
Weak interaction of citizens	4	16.0
Technical constraints (Irri., tree sp., etc)	5	20.0
All answers	5	20.0
None	1	4.0
1&2	2	8.0
Total	25	100.0

Technical constraints of the urban environment, insufficient local participation, sustaining funds for urban forests are challenges for urban forestry development.

Chapter Six

6. Summary, Conclusions , Recommendations and proposed thesis

6.1 Summary

Urbanization is an old phenomenon, during the Nubian times the city was the center of power and decision making. Khartoum is the biggest city in the country and becomes the favorite place for living, population growth rate has exceeded 6% urban population in 1993 representing 11.4% of the total population of the Sudan and 42% 0f the urban population of the total urban population of the country, 81.1% of the population live in urban center. An increasing demand for urban services in general and housing in particular resulted in an organized housing encroachment upon the arable land. Khartoum Green Belt an area of 7.o35 feddans was planted to supply the city with fire wood ,building poles, to provide recreation services for citizens, training for students, and other benefits. This belt has been cleared for expansion of new residential area.

Khartoum arboretum and forest nursery 22 feddans, more than 80 tree species were planted in this arboretum mostly indigenous species of most timber, shade, ornamental or wild fruit bearing trees, most of this collection now completely disappeared indicating that an important species were extinct as a result of miss-management, also trees suffered from the negative attitudes of urban dwellers through debarking of trees for local medical uses. This situation needs more attentions to trees inside and around the city.

The survey conducted for the different sites indicates Khartoum is still characterized by tree species diversity, this survey will help in the definition of the stakeholders of each site to facilitate the management of those trees and hence the development of urban and peri- urban forestry. The urban forestry addresses the planning and management of all city trees whether they are in streets, in parks, or around homes . Also there are 9 reserved forest in the state with an area of 121274 feddans, and 171 forests under reservation process area of 657046 feddans (FNC). These forests can be rehabilitated and manage properly and their products can generate income for people besides to others benefits including environmental services.

The study presents how far citizens in Khartoum state have consumed forest products, this indicates the relationship between urban dwellers and trees or forests. The main component of the success of the development of urban and peri-urban forest is the community, the perceptions of the people in different issues related to tree planted also presented in the study. The most important factor in developing UPF is the people awareness about importance of trees in theirs environment, the study shows that people are well aware but they need some assistance.

6.2 Conclusions

Forest cover in Khartoum State is declining as a result of various factors including on going urbanization, clearance for wood, agriculture and intensive grazing.

The per capita wood consumption is the highest at Khartoum because of the large population.

Khartoum urban forest is characterized by high biodiversity including seventeen planted and naturally growing other Species.

Indigenous species growing on many sides inside or in the periphery of the urban areas in Khartoum State, are potential producers of many forest products although, their existence are rare.

Citizens plant trees for different purposes and uses, the peri-urban citizens have theirs own uses for tree products that differ from urban citizens.

National statistics on population and results of survey on urban expansion indicates a need to improve the health of urban forests, and to increase programs emphasis on long term tree planting, monitoring, care, and maintenance

Tree planting activities can be affected by the economic condition of the society. The shared houses, due to financial constraints discourage people from planting trees. The potential for new urban forestry efforts are relatively limited in most of quarters characterized by small area. In peri-urban areas more scope exists for tree planting; the availability of land is greater.

Private nurseries can contribute positively in the processes of the tree planting activities through provision of seedlings and other services, and hence the development of urban and peri-urban forests.

Location of nurseries is not an obstacle or constraints to discourage people from obtaining seedlings and planting trees. Although most of the respondents have no nursery near them, but most of them have planted trees.

People are not well organized in tree planting programmes and more efforts are given to preparation stage and limited efforts are directed to other

activities. Although, they are contribute in various forms towards tree planting activities.

The awareness of people about trees and their interest to participate in tree planting activities to rehabilitate theirs quarters and villages will improve the status of tree cover in the state.

There are some factors contributing to increase people awareness and willingness. They positively influence each other through competitions to plant trees, these results in increasing public activities towards greening of urban centers.

Presence of forest extension agents or environmental societies and even a trained person in the field of forestry, at the level of villages and quarters strengthen and support the community by giving advice and services when needed to face the technical problems with regard to selection of tree species that suitable to the concerned sites.

Development of UPF requires provision of incentives and assistance to the community according to their need and interest in provision of assistance to help to increase people's participation.

There are many constraints hindering people from planting trees, these constraints consider as an obstacle towards development of urban and peri-urban forests. Generally tree planting activities are in a progress, but more efforts are needed. Lack of coordination, technical problems (irrigation, selection of tree species and sites…etc) are major constraints in developing tree planting.

There are many organizations and institutions working in the field of tree planting programs and they contribute to the greening of the state, but there is no body authorized to carry the process of coordination between those

organizations and to unify the programmes of tree- planting activity in the state to come with one strategy.

Citizens are playing or played very important role in planting trees in the present and in the past. This indicates the importance of involvement of community in forestry–related programmes to guarantee the sustainability of trees.

Education does not affect the level of participation and interest of the people and educated persons should be more understating to his environment and have positive contribution to the society.

6.3 Recommendations

Conservation and development in urban forest is recommended as it may make Khartoum an important contributor in environmental conservation related to forestry.

Develop of comprehensive urban and community forestry programs that address urban tree health issues and implement long term tree practices and strategies are recommended.

It is recommended to enhance community participation in forest- related activities from the choice of tree species to actual planting, and harvesting of tree products.

People’s needs, opinions and preferences should be incorporated into the planning and management process. In addition to provision of assistance and incentives such as seedlings distribution and extension services.

All tree planting projects should include maintenance plans and use plant materials that meet the tree health.

Definition of rights and responsibilities for all stakeholders with regard to different sites for proper management and supervision is recommended.

Capacity building and training of CBOs in tree establishment to avoid technical problem is recommended.

The proliferation of private nurseries has positive and also negative effects towards development of UPF so they should supported and should be under control and supervision particularly with regards to the species planted.

It is recommended to develop and implement technology transfer programs in urban forest health and management that are tailored to identify training and informal needs, and preferred educational outreach methods.

It is recommended to define and agree upon an authorized unit to carry the coordination of programmes and distribution of responsibilities between different institutions and organizations involved and interested in urban forestry development.

Rural–urban migration phenomenon impact on urban forestry programmes should be taken in consideration by the planners. This will help predict what forest/ tree related goods and services they need and the impact they may have on forest and tree resources.

Support for implementing the recommendations is needed to ensure that urban trees survive and reach their maximum potential for providing ecological,

economic, and health- related benefits to the growing number of citizens living in urban areas.

6.4 Proposed thesis

- Suitable species to be planted in urban areas
- Pollution of trees along streets
- Advantages and disadvantages of trees inside cities
- Negative attitude of citizens towards trees and its effects on development of urban and peri-urban forests.

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